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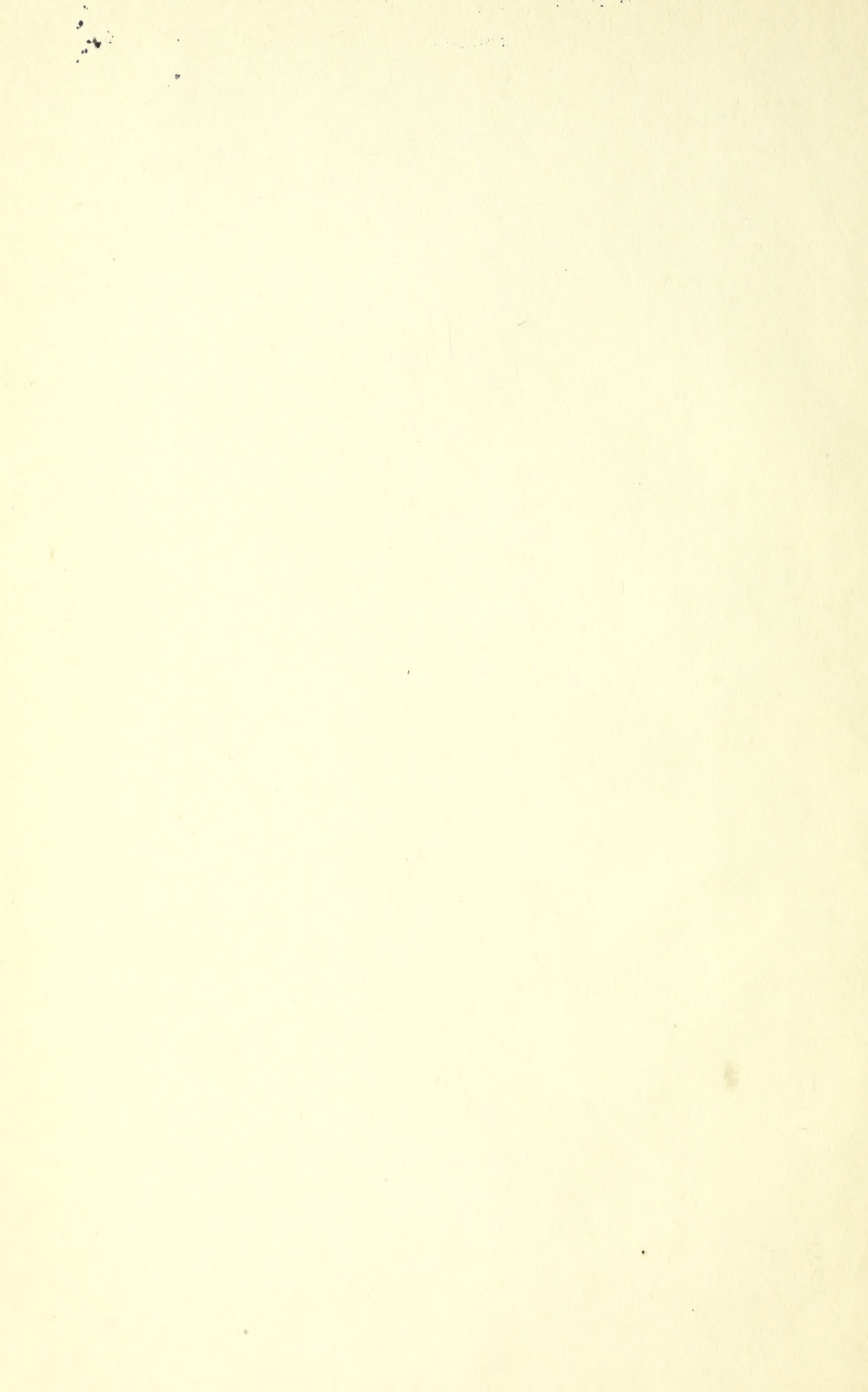






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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

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ECONOMIC PAPER No. 22

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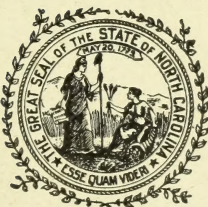
# FOREST FIRES AND THEIR PREVENTION

INCLUDING

## FOREST FIRES IN NORTH CAROLINA DURING 1910

BY

J. S. HOLMES, Forester



RALEIGH  
EDWARDS & BROUGHTON PRINTING COMPANY, STATE PRINTERS  
1911

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## LETTER OF TRANSMITTAL

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CHAPEL HILL, N. C., August 1, 1911.

*To His Excellency, HONORABLE W. W. KITCHIN,*

*Governor of North Carolina.*

SIR:—I herewith submit for publication as Economic Paper 22 of the reports of the North Carolina Geological and Economic Survey a report on Forest Fires and their Prevention, including statistics regarding Forest Fires in North Carolina during 1910, which has been prepared by Mr. J. S. Holmes, Forester to the Survey. The statistics are more complete and accurate than those collected for 1909 and more intelligent answers were received from inquiries during this second year of collection.

Yours respectfully,

JOSEPH HYDE PRATT,

*State Geologist.*





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# FOREST FIRES AND THEIR PREVENTION

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By J. S. HOLMES.

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## INTRODUCTION.

During 1909 the United States Forest Service attempted to collect uniform data on the prevalence and destructiveness of forest fires in all the various States. The North Carolina Geological and Economic Survey co-operated with the Forest Service in this work in this State, and got together some very interesting figures. Though admittedly incomplete, these were published by the State Survey in Economic Paper No. 19, "Forest Fires in North Carolina During 1909." This publication has been scattered widely through the State, and is still available for distribution. It should be read in connection with the present report in order to best understand the application of the figures and to obtain much information which it was thought best not to repeat.

Owing to the failure of many of the States to obtain sufficient reliable information, the general fire study of the Forest Service, which was intended to be annual and permanent, has been discontinued. The North Carolina Geological and Economic Survey then had to decide as to the advisability of continuing the collection of these figures unaided. Though the data collected last year was far from satisfactory, still it was thought that the economic and educational value of such figures was great enough to warrant the expense of collecting them. With the hope, therefore, of increasing their accuracy and broadening their influence, the Survey determined to continue the collection of this information in regard to the annual destruction by forest fires.

Accordingly, as soon as the year closed, question blanks were sent out to about eight hundred correspondents in all parts of the State, together with a stamped envelope for reply. These forms contained the same questions that were asked last year, but, in order to make the replies more definite and accurate, the correspondents were asked to confine their figures to one or more specified townships, and not try to estimate for the whole county. This method has succeeded much better even than was expected. No correspondent attempted to answer for more than one or at the most, two townships, and, as a consequence, the figures included in this report, though attempting to represent an even smaller part of the State than last year, are, it is thought, considerably more accurate. Still it must not be forgotten that all figures given are



estimates, and sometimes only very rough estimates at that, as it would have been impossible to obtain definite figures without an immense amount of trouble and expense.

### THE WEATHER IN 1910.

As the condition of the weather, especially the amount and local distribution of the precipitation has a great deal to do with the frequency and severity of forest fires, a brief review of the weather conditions for 1910 will add interest and value to this report.

The past year was noteworthy for two quite severe droughts, extending over the entire State, though generally more severe in the eastern part. The greatest deficiency in precipitation occurred in March, the rainfall for that month being less than for any previous March for which there are any records. Practically no rain fell after March 12th. This droughty condition, which lasted up to the middle of April, and was accompanied by high winds, made the danger from forest fires very great. Destructive fires broke out in many counties before the end of March and continued with increasing frequency and severity up to the middle of April, when a general rain restored normal conditions. June was a wet month, the rainfall all over the State being markedly in excess of the normal. Heavy summer rains continued at intervals until September, when dry weather again commenced, though in the mountains rain fell generally until October. The fall drought lasted until December 3d. November was very dry, only about one-fourth of the normal rainfall occurring over the whole State. Very severe fires occurred during this season, both in the mountains and in the eastern part of the State. Altogether, the year 1910 showed a slightly greater rainfall than the previous year, though a little less than the normal amount of precipitation was recorded.

### TABULAR STATEMENT.

The following tables have been compiled from the information furnished by voluntary correspondents all over the State. There was only one county which did not send in any report, and most counties were represented by three or four correspondents. This, it is realized, is quite insufficient to get complete reports, but it is enough to give some idea of the magnitude of the loss which is yearly experienced, and this, it must be remembered, is the chief object of these tables. It is hoped that another year the number of voluntary correspondents may be greatly increased, thereby enabling the Survey to publish much more complete figures.



TABLE 1.—FOREST FIRES IN NORTH CAROLINA DURING 1910. COMPARATIVE STATEMENT. SUMMARY OF REPORTS FROM CORRESPONDENTS BY REGIONS, FOR 1910 AND 1909.

	Mountain.		Piedmont.		Coastal Plain.		State.	
	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.
Total number of townships in region	166	-----	450	-----	364	-----	980	-----
Number of townships reporting.....	51	-----	146	-----	131	-----	328	-----
Number of replies received.....	48	47	142	61	131	50	321	158
Number of forest fires reported.....	136	249	258	86	312	272	706	607
Total area burnt over, in acres ....	80,825	166,295	158,948	100,670	339,780	139,100	579,553	406,065
Total area growing merchantable timber burnt over, in acres.....	64,250	128,145	46,839	77,735	142,010	51,025	253,099	256,905
Total area of second growth, not yet merchantable, burnt over, in acres.....	7,190	13,100	55,712	14,555	78,735	27,050	141,637	54,705
Total area of cut-over land burnt over, in acres.....	9,385	25,050	56,397	8,380	119,035	61,025	184,817	94,405
Total standing timber destroyed in M. ft. bd. measure.....	6,915	17,325	12,553	11,027	42,550	9,280	62,018	37,632
Value of timber destroyed, in dollars.....	\$ 25,095	\$ 47,520	\$ 35,930	\$ 33,374	\$108,995	\$ 26,360	\$170,020	\$107,254
Value of forest products destroyed, in dollars.....	\$ 28,215	\$ 17,075	\$100,415	\$ 39,425	\$129,545	\$ 30,245	\$258,175	\$ 86,745
Value of improvements destroyed, in dollars.....	\$ 19,375	\$ 26,550	\$ 25,615	\$ 14,750	\$ 53,805	\$ 17,105	\$ 98,795	\$ 58,405
Number of lives lost.....	1	0	1	0	3	0	5	0
Cost to private individuals to fight fire.....	\$ 13,155	\$ 6,650	\$ 10,503	\$ 1,059	\$ 11,780	\$ 6,355	\$ 35,438	\$ 14,064

TABLE 2.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.  
COASTAL PLAIN REGION.

Counties.	Total No of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.				Merch. Timber Destroyed, M.	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fighting Fire.
					Total Area Burnt—Acres.	Merch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.						
Beaufort.....	6	2	2	4	3,000	1,500		1,500	5,000	\$ 7,500	\$	\$ 1,000		\$
Bertie.....	9	4	4	14	13,450	2,400	1,050	10,000	120	300	15,200	4,250		625
Bladen.....	15	6	7	14	15,900	10,700	3,200	2,000	10,950	20,300	12,800	1,500		800
Brunswick.....	6	3	2	11	25,500	10,200	300	15,000	900	2,100	200	5,050		25
Camden.....	3	2	2	0										
Carteret.....	9	2	2	7	15,000	9,000		6,000	1,400	2,700	2,000	1,000		50
Chowan.....	4	3	4	2	2,000		1,000	1,000						
Columbus.....	14	3	4	28	70,500	45,500	5,000	20,000	2,125	3,400	6,500	11,200	2	3,050
Craven.....	9	4	4	7	6,000	2,000	1,500	2,500	100	600	20,000			
Cumberland.....	12	7	6	37	53,200	21,150	20,650	11,400	4,320	18,300	6,300	11,000	1	2,550
Currituck.....	5	4	5	1										
Dare.....	5	3	3	0										
Duplin.....	13	5	5	6	1,090	520	50	520	255	2,800	3,350	455		225
Edgecombe.....	14	1	1	0										
Gates.....	7	5	4	15	3,650	2,225	725	700	3,020	6,660	14,030	1,220		1,100
Greene.....	10	3	3	1	10	10								
Halifax.....	12	3	3	16	3,250	600	1,150	1,500		6,000	1,500	1,000		210
Harnett.....	13	5	4	13	62,000	8,500	22,900	30,600	3,010	9,020	12,000	6,000		300



Hertford.....	6	4	3	5	450	400	50	100	350	5,000	250	1,500
Hyde.....	4	2	2	5	2,000	500	1,500	200	500	250		
Johnston.....	16	3	3	0								
Jones.....	7	1	1	2	10,000	10,000		500	1,000	10,000		
Lenoir.....	12	7	7	7	5,200	3,400		200	5,400	8,000	2,300	400
Martin.....	10	1	1	0					1,800			
Nash.....	12	5	4	8	1,400	600	350	90	350	450		60
New Hanover.....	4	1	1	12	1,000		500					
Northampton.....	9	2	3	3	25	25		10	30	30	100	25
Onslow.....	5	2	2	5	7,000	4,500	2,500	2,500			100	
Pamlico.....	4	5	4	21	14,175	4,160	3,000	1,510	3,020	585	150	25
Pasquotank.....	6	3	3	5	320	310	10	20	60		10	
Pender.....	10	1	1	3	5,000		5,000	200	200		100	50
Perquimans.....	5	3	3	4	350	200	50				20	
Pitt.....	11	6	8	14	9,800	1,000	5,700	5,000	16,000	5,580	5,075	50
Richmond.....	7	3	3	20	2,800	500	1,450	200	600		500	200
Robeson.....	19	3	3	4	1,500	1,000	500	80	160	100		75
Sampson.....	16	2	2	3	1,000	300	100	550	775	3,000	300	200
Scotland.....	4	1	1	2	2,000	300	200	10		2,000	1,000	
Tyrrell.....	5	1	1	0								
Washington.....	4	3	2	1	500	250	250					
Wayne.....	12	6	7	12	710	360	50	180	870	670	225	260
Wilson.....	10	1	1	0								
	364	131	131	312	339,780	142,010	78,735	42,550	\$108,995	\$129,545	\$53,805	3 \$ 11,780

TABLE 3.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES. PIEDMONT REGION.

Counties.	Total No. of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.				Merch. Timber Destroyed. M.	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fire-fighting.
					Total Area Burnt—Acres.	Merch. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.						
Alamance.....	13	6	5	5	3,100	1,000	1,000	1,000	50	\$ 400	\$ 1,000	\$		\$
Alexander.....	8	5	6	3	250	200	50		510	1,250	500	200		
Anson.....	8	0	0	0										
Burke.....	11	2	2	12	10,000	8,000	2,000		2,000	4,000				
Cabarrus.....	12	3	4	5						1,000				
Caldwell.....	12	4	3	9	5,300	2,100	1,000	2,200	300	600	1,200	1,100		300
Caswell.....	9	3	3	0										
Catawba.....	8	5	3	2	50	15		35		100				
Chatham.....	14	4	4	8	1,760	675	790	295	1,020	1,480	1,300	1,000		
Cleveland.....	11	3	3	3	50	18	22	10	50	125				
Davidson.....	17	6	5	4	34	14	1	19	2	160	20	5		
Davie.....	7	2	4	1	50	25	25				25	800		
Durham.....	6	1	1	1	100	75	25							
Forsyth.....	14	3	3	1	75		40	35				25		20
Franklin.....	10	4	4	14	1,650	500	200	950	85	150	1,000	200		2,600
Gaston.....	6	3	2	1	40	15	25		80	400	400			
Granville.....	9	4	5	7	200	100		100			500			
Guilford.....	18	2	2	0										
Iredell.....	16	6	6	13	1,435	915	400	120	350	1,700	1,500	2,225		250



Lee.....	7	4	4	24	1,450	725	135	590	675	2,800	275	1,000	---	535
Lincoln.....	5	2	2	1	75	60	5	10	150	500	500	1,000	---	---
McDowell.....	10	5	5	16	19,500	9,750	8,000	1,750	145	3,665	2,800	550	1	1650
Mecklenburg.....	15	6	4	3	16	11	5	---	10	650	---	1,400	---	---
Montgomery.....	11	5	5	4	39,100	8,030	8,020	23,050	600	1,200	20	30	---	50
Moore.....	9	4	3	22	51,000	4,100	26,400	20,500	1,100	3,300	75,100	12,200	---	4,025
Orange.....	7	5	2	5	25	---	25	---	---	---	---	---	---	---
Person.....	9	3	2	1	50	30	10	10	---	---	---	---	---	10
Polk.....	6	6	8	38	12,900	5,300	4,000	3,600	290	580	5,040	460	---	65
Randolph.....	19	3	3	7	500	175	100	225	25	55	---	200	---	200
Rockingham.....	11	1	1	0	---	---	---	---	---	---	---	---	---	---
Rowan.....	14	5	6	5	500	200	90	210	---	---	---	2,000	(?) 1	100
Rutherford.....	12	2	1	7	600	---	600	---	---	---	---	---	---	100
Stanly.....	8	2	2	3	300	205	85	10	103	765	1,505	400	---	25
Stokes.....	8	4	4	6	320	158	109	53	5	30	10	---	---	---
Surry.....	14	4	4	0	---	---	---	---	---	---	---	---	---	---
Union.....	9	1	1	0	---	---	---	---	---	---	---	---	---	---
Vance.....	8	4	5	2	210	210	---	---	---	---	---	20	---	5
Wake.....	19	1	1	0	---	---	---	---	---	---	---	---	---	---
Warren.....	12	4	3	14	5,100	1,025	2,550	1,525	---	---	5,500	---	---	510
Wilkes.....	20	5	6	3	3,008	3,008	---	---	5,003	10,020	2,020	700	(?) 1	58
Yadkin.....	8	4	5	8	200	100	---	100	---	1,000	200	100	---	---
	450	146	142	258	158,948	46,839	55,712	56,397	12,553	\$ 85,930	\$100,415	\$ 25,615	5	\$ 10,503

TABLE 4.—FOREST FIRES IN NORTH CAROLINA DURING 1910. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.  
MOUNTAIN REGION.

Counties.	Total No. of Townships in County.	No. of Townships Reporting.	No. of Replies.	No. of Fires.	Area Burnt Over.				Mern. Timber Destroyed M	Value of Timber Destroyed.	Value of Products Destroyed.	Value of Improvements Destroyed.	Lives Lost.	Cost of Fighting Fire.
					Total Area Burnt—Acres.	Mern. Timber—Acres.	Second Growth—Acres.	Cut-over—Acres.						
Alleghany.....	8	1	1	0	—	—	—	—	—	—	—	—	—	—
Ashe.....	15	1	1	1	150	100	—	50	500	\$ 1,250	\$ 1,500	\$ 100	—	—
Buncombe.....	13	5	4	6	1,300	1,000	150	150	300	900	—	—	—	100
Cherokee.....	6	2	2	25	4,000	4,000	—	—	10	50	500	200	—	—
Clay.....	5	3	3	9	1,500	1,300	160	40	30	70	45	—	—	65
Graham.....	3	2	2	7	18,000	14,700	—	3,300	700	3,700	3,000	300	—	100
Haywood.....	13	6	6	17	5,100	3,190	1,050	860	1,000	3,000	—	5,000	1	10,205
Henderson.....	8	5	6	13	7,000	5,050	1,075	875	70	1,650	420	800	—	200
Jackson.....	15	2	2	25	10,000	10,000	—	—	200	1,000	1,000	25	—	25
Macon.....	11	6	4	14	10,000	9,000	1,000	—	—	—	10,000	1,000	—	1,000
Madison.....	16	2	2	2	1,100	900	100	100	2,000	4,150	50	50	—	510
Mitchell.....	14	5	5	4	4,900	4,400	500	—	5	15	1,000	1,700	—	450
Swain.....	5	2	3	6	7,200	3,200	1,600	2,400	—	1,210	10,700	—	—	500
Transylvania.....	9	2	2	3	75	10	55	10	—	—	—	—	—	—
Watauga.....	14	6	4	4	10,500	7,400	1,500	1,600	2,100	8,100	—	10,200	—	—
Yancey.....	11	1	1	0	—	—	—	—	—	—	—	—	—	—
	166	51	48	136	80,825	64,250	7,190	9,385	6,915	\$ 25,095	\$ 28,215	\$ 19,375	1	\$ 13,155



FOREST FIRES AND THEIR PREVENTION.

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TABLE 5.—COMPARATIVE STATEMENT OF AVERAGES BY REGIONS FOR  
1910 AND 1909.

	Mountain.		Piedmont.		Coastal Plain.		State.	
	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.
Percentage of townships reporting..	31	-----	32	-----	36	-----	33.5	-----
Average area of each fire, in acres..	594	668	616	1,171	1,089	511	821	667
Average damage by each fire, in dollars.....	631	393	668	1,030	974	294	775	439
Average area burnt over per township reporting, in acres.....	1,585	-----	1,089	-----	2,594	-----	1,805	-----
Average damage per acre, in cents.	1.06	.59	1.08	.88	.90	.57	.97	.66
Average cost to fight fires per acre burnt over, in cents.....	.16	.04	.06	.01	.03	.04	.06	.03½

NUMBER OF FIRES.

Of the 800 blanks sent out, only 320, or 41 per cent, were filled out and returned. Though these covered only one-third of the townships of the State, it is probable that they include the greater part of the more important fires, though many other fires have occurred in townships not reported on. This has been ascertained from clippings taken from the local press of the State, which mention additional fires in at least ten counties.

No doubt many fires also took place in townships making reports which the correspondents, owing to their location in a different part of the township, had not heard of.

From tables 1, 2, 3, and 4 it will be seen that 726 fires were reported, or an average of a little over two fires to the township reporting. This is only slightly in excess of the total number of fires reported for 1909. While there were barely half the number of fires reported from the mountain region, there were nearly three times as many in the Piedmont region as were reported for 1909. This is probably due in large part to the two droughts, which were so severe over the eastern part of the State, and which were much less felt in the mountains. The comparatively small number of replies received from the western part of the State might also partly account for it.

AREA BURNT OVER.

About 580,000 acres of land were reported burnt over during 1910. This is 43 per cent in excess of the amount burnt over last year. The comparative freedom of the mountain counties from fires shows itself in the 80,000 acres burnt over, which is less than half that was burnt over in that region in 1909.

Nearly half of the burnt-over area of the State was supporting a growth of merchantable timber, though probably the greater part of it had been culled to some extent. The division of the area into merchantable timber, second growth, and cut-over, is only approximate and can not be taken as definite figures. Nearly all merchantable timber in the hardwood forests contains more or less second growth, while a great part of the cut-over lands also contains much young growth. Such figures, therefore, can not be accurate, and are of use chiefly in giving some idea of the damage done by fires.

#### MERCHANTABLE TIMBER DESTROYED.

The amount of merchantable timber destroyed, compared with the area burnt over containing such timber, appears to be very small. This is due to the fact that, as a rule, mature timber is not killed outright by the ordinary forest fires in this State, unless the fire occurs in the late spring. Most fires, however, do seriously injure mature standing timber, and often the death of timber which is attributed to insects is really primarily caused by forest fires. In spite of this, however, there is a reported loss of 62,000,000 feet of merchantable timber from fires. This is nearly twice as much as was reported destroyed in 1909.

#### FOREST PRODUCTS DESTROYED.

The value of forest products destroyed in 1910 is about three times as much as that listed for 1909, and amounts to over a quarter of a million dollars. This includes sawlogs, lumber, cordwood, bark, and other material.

Although this large item of loss is no doubt much below the real figure, it is, however, enough to make people realize the advisability of taking active steps to prevent such fires.

#### IMPROVEMENTS DESTROYED.

Farm improvements, chiefly fences and outbuildings, are included under this head. Ninety-eight thousand dollars was lost by the destruction of this class of property alone, more than half of it in the Coastal Plain region. This, as will be seen from Table 1, is also largely in excess of that of 1909.

#### LIVES LOST.

The year 1910 will long be remembered as one of the most destructive to life and property from forest fires throughout the country. During the month of August scores of lives were lost in the forest regions of the northwestern States.



Though we are apt to think that our fires are altogether different from those in the West, yet a loss of five human lives through forest fires occurred in North Carolina in 1910. Besides the woman burnt in Cumberland County, referred to in last year's report, a colored girl and an old woman were burnt to death in Columbus County while trying to protect their property from the flames. Two men lost their lives fighting fire in the western part of the State, one in Haywood County, and the other one near Marion in McDowell County. Such deaths are usually spoken of as accidental, but they are preventable accidents, for they would not have occurred had it not been for the criminal carelessness of those who let the fires get out.

#### COST TO FIGHT FIRES.

More than \$35,000 was spent by private individuals and lumber companies in 1910 in extinguishing forest fires, or two and a half times the amount spent the previous year. This does not comprise the total cost of fighting fire even in the townships reporting, for, as a rule, small fires and those on private land are fought, when any effort is made to extinguish them, by the voluntary help of the neighbors. A glance at the figures in Table 5 shows that about sixteen cents per acre burnt over was spent in the Mountain region to fight fires, while only about three cents per acre was spent in the Coastal Plain. This does not mean that the mountain people are not willing to fight fire unless paid for it, for they are just as ready as any one else to assist their neighbors in such emergencies. It means that the lumber companies and other timberland owners of that region are more alive to the destruction caused by fire than those of the Coastal Plain region. This is partly because many owners of mature timber in eastern North Carolina still burn to protect their timber from more destructive conflagrations, but chiefly because many of the eastern lumbermen own the timber without the land, and so have no interest in protecting the young growth, while those in the Mountain region usually own both land and timber and are anxious to keep fire out. It is an encouraging sign that while twice as much was spent in 1910 in fighting fires in the mountains as was spent in 1909, only half as great an area was burnt over. While the weather was in part responsible for this there is no doubt that the increasing watchfulness and effort on the part of landowners is bringing results.

#### LOSS FROM FIRE NOT INCLUDED IN THE TABLES.

A loss of considerably over \$500,000 in one-third of the townships of the State seems a large sum, and yet it is far from representing the



entire damage, even of the fires that were reported. The injury to the standing timber which is not killed is often just as heavy as that caused by the destruction of the trees.

The damage done to young growth and reproduction is usually considerably greater than that done to the mature timber, but as it is in most cases difficult to put a cash value on this young growth, because it has no sale value, it is usually left out of all estimates of damage. There is now, however, a tendency to take into account the young growth destroyed by a fire, as is evidenced by two correspondents; one in the mountains, who estimated a loss of \$5 per acre in the destruction of young growth; the other on the coast, who put down a loss of \$1,000 in young growth, caused by burning over 500 acres of land. These, which are no doubt very conservative estimates, go to show that some landowners are realizing the loss to the future forest that is taking place. Next year an attempt will be made by the Survey to get correspondents to include damage to young growth by furnishing question blanks with a space for this purpose.\*

The gradual killing out and disappearance from the forest of such valuable species as poplar, white pine, and chestnut, and the substitution for them of the inferior, though more fire-resistant kinds, means a serious loss to the landowner which will be appreciated more thoroughly by the next generation because the change is comparatively slow. Such a loss is hard to estimate for any one year, but it will manifest itself in the gradual decline in the value of the property.

The gradual, though certain, impoverishment of the soil through the constant burning of the leaves, causes great loss in the value of the land on which the forest is growing. This loss shows itself in the slower growth of the trees and in the decline in value of the land for agricultural purposes.

The washing of the soil by the rains is one of the forms of damage caused by forest fires. The coating of leaves protects the top soil, and when this is removed the rains rush off to the streams, removing the surface soil, and filling up the streambeds with silt and sand, thereby damaging the land and seriously interfering with the navigability of the streams.

#### CAUSES OF FOREST FIRES.

The principal causes of forest fires, as given by the various correspondents for their own townships, have been compiled and are given in percentages in Table 6.

\*Damage to young growth from forest fires is discussed pretty fully in Economic Paper 19, "Forest Fires in North Carolina During 1909," page 25.



TABLE 6.—CAUSES OF FOREST FIRES IN THE DIFFERENT REGIONS OF NORTH CAROLINA IN 1910, IN PERCENTAGES.

	1910.				1909.
	Moun- tain	Pied- mont.	Coastal.	State.	State.
Farmers burning brush, grass, rubbish, etc.....	8	23	7	13	10
Hunters.....	2	6	6	6	16
Cigars, cigarettes, matches, etc.....		5	2	3	3
Careless and negligence of individuals.....	11	23	22	20	15
Railroad locomotives, sparks from.....	18	13	27	20	17
Logging locomotives, dummy engines, etc.....	8	3	15	9	5
Sawmills, etc.....		10	2	5	3
Traction engines.....		3		1	
Accidental, caught from burning buildings, etc.....		2	1	1	1
To improve the range.....	8	1	3	3	4
Set by chestnut gatherers, root diggers, etc.....		1			2
Without much object, to see it burn, etc.....	13			2	13
Malice or incendiary.....	16	6	7	9	4
Unknown causes.....	16	4	8	8	7

This table shows that over three-fourths of the fires reported from all over the State were thought to be unintentional. Forty-two per cent of all the replies given by correspondents can be classified under the head of individual carelessness, which is practically the same figure as was obtained last year. In the Piedmont region, however, where burning to improve the range is practically eliminated as a cause of fires, fifty-seven per cent of the correspondents attributed the fires to individual carelessness. Farmers burning brush, grass, stumps, and rubbish are said to be responsible for about one-third of these "individual" fires, while probably a majority of those attributed to general carelessness should come under this head. This is by far the most frequent cause of fires originating from the individual. More care in the setting of such fires, and watching them till they are burned out and harmless, would prevent many of the most serious and destructive fires.

Sparks from engines is a very fertile cause of forest fires, over one-third of the correspondents giving this as the principal cause in 1910. Railroad and logging locomotives are the chief offenders, twenty-nine per cent of all the correspondents accusing them. This is considerably more than fell to their share in 1909. These railroad fires are in large part preventable, and as soon as property owners along the lines of railroads unite in demanding protection, it can be secured.



According to the above table, intentional fires are most frequent in the Mountain region, where thirty-seven per cent are said to be purposely set. This is a large proportion, though it is an improvement over the report for the previous year, which showed that in the mountains nearly half the fires were set on purpose. This large number of intentional fires is in part due to the destructive habit of burning the woods to "improve the range" for loose cattle, which ought to be confined to their owner's land, and in part to an unfortunate feeling of antagonism in some localities against large landowners who are trying to protect their forests. The large increase in malicious or incendiary fires all over the State is a regrettable feature of the 1910 figures and one that is not easy to explain. It indicates very clearly, however, that more stringent laws and better law enforcement are needed in order to check this nuisance.

#### PREVENTIVE AND PROTECTIVE MEASURES.

We have in North Carolina a reported loss from forest fires in 1910 of \$560,000. This report covers only one-third of the townships of the State, and does not include injury to standing timber, damaged, but not killed; to young growth; to soil and streams by any of the fires. There can be little doubt, therefore, that the total loss through forest fires in North Carolina during 1910 amounted to at least a million dollars. In addition to this there was very serious loss of life from the same cause. Is it not time that North Carolina as a State, and we as individuals, took some steps to abate this nuisance?

If there was any one measure that would stop these fires we could easily be persuaded to adopt it, but, unfortunately, there is no such specific. There is, however, much that we can all do and the following preventive and protective measures are strongly advocated.

#### PRIVATE MEASURES.

The owner of woodland, whether a corporation or a private individual, can do much towards protecting his property from fire, though to achieve the greatest success all such efforts should have the hearty co-operation of the community and the State. Fire lines cleared out around or through a property are very effective in stopping a moderate fire. When a strong wind is blowing and the fire is very heavy, such a fire line is invaluable as a vantage ground from which to start a back fire. Adequate fire lines can be constructed at from \$10 to \$50 per mile, according to the nature of the ground over which it has to be made. Such a fire line has been made over the rough mountain country of northeast McDowell County at less than the higher figure.



Patrol is probably the most effective single means that the individual can put into practice, though quite expensive. Efficient patrol will cost from one to three cents per acre per year. Some companies, especially in the mountainous part of the State, employ one or more men to look after their forest land, and often part of their duty is patrolling. If this were more generally practiced many fires would be prevented, and many more extinguished before they had gotten beyond control.

Warning notices, calling the attention of the passers-by to the danger of forest fires, are used to a large extent in the National Forests of the West, and are employed on many of the private or corporate holdings in the North and East, and to some extent in the South, though in this State they are little used, except to include a prohibition against setting fire to the woods in a general trespass notice. A carefully-worded reminder, posted where it will be seen and read, is calculated to help materially in suppressing the "careless" fire.\*

Farmers can do much to prevent the disastrous spring fires by burning in the winter as much as possible what brush and rubbish it is necessary to remove in this way, and by never leaving even an innocent-looking fire until it is quite out. Renters, who very often own no land and are absolutely irresponsible, should be bound by a contract not to set out fire in dry weather. If every renter who let fire escape and burnt up his landlord's woods were in the future denied a place to rent in that neighborhood, this class of offenders would learn to be more careful.

A stipulation against setting fire to the woods should always be included in a contract for the sale of timber. There is no more reason for the purchaser of mature timber to destroy all the reproduction and young growth on the ground by fire than there is for a man who buys the apple crop to cut down and destroy an orchard in order to harvest the fruit, and the sooner landowners realize this the better it will be for their interests.

#### CO-OPERATIVE ASSOCIATIONS.

Co-operation between individuals for the purpose of fire protection adds very much to the effectiveness of private efforts. The individual suffers as much and sometimes more from fires that start beyond his boundary than from those originating on his land; especially if he is patrolling and his neighbor is not. No matter how careful a man may be or how much he spends on fire protection, the fires that originate and develop great headway before they come onto his property, can not be controlled. Besides the attainment of efficiency through co-operation,

\*Fire lines, fire patrol and fire notices are more fully discussed in Economic Paper 19, "Forest Fires in North Carolina During 1909," pp. 43-47.



the cost of protection is reduced to a minimum. One man can patrol much more territory if he feels responsible for all the area that comes within his vision than if he has to look out for boundary lines and his operations are restricted. Some form of co-operation is essential for the most successful fire-fighting.

The value of co-operative associations has been pretty clearly demonstrated in several of the far western States during the past two or three years. Two separate kinds of associations for forest protection have been formed; the one chiefly educational, the other engaging in the actual protective work.

*Associations Chiefly Educational:*—The Oregon Forest Fire Association is a representative of this class. It does not itself engage actively in fire work, but is a rather loose affiliation of individual patrol systems, each doing its fire work independently, but using the central facilities for legislative and publicity purposes and particularly to stimulate the installation of further individual patrols. The formation of local co-operative patrol associations is also encouraged. In fact, its main purpose is for the general promotion of patrols in the State, of giving out information regarding the best methods of protection, endeavoring to induce the public to be more careful in the use of fire, and trying to persuade owners to maintain patrols. There is a large amount of work of this nature to be done and it will help the general movement, but of course, the only way to prevent fires is to have patrolmen on the ground. Such an association denotes a less advanced stage in co-operative effort—for a large number of independent patrols cannot equal systematic co-operative management of the work in either economy or results—nor does it have the same public standing. Moreover, without actual work to do the association finds it hard to gain members or preserve its solidarity. Such an organization in North Carolina would not be of the greatest value. The field is covered already, to a certain extent, by the North Carolina Geological and Economic Survey, which is only kept from doing much more in this line by lack of funds.

*Associations Chiefly Protective:*—What is wanted among timberland owners in North Carolina is a close organization which can go ahead and carry out patrol and other means of protection. This is being done in the northwest by the Washington Forest Fire Association and the several Idaho timber protective associations, which latter, it is generally conceded, afford the most efficient protection in the country. The organization of these Associations includes a board of directors who have power to levy and enforce the payment of assessments to defray expenses in proportion to the number of acres owned by each member.



The actual work of protection is put in the hands of a committee which hires patrolmen and fire fighters and incurs all other expenses necessary to protect the territory from forest fires. In one of the most successful of these Associations the patrol averages one man to sixteen thousand acres, and although they have had some hazardous seasons their loss has always been very small. It is figured that it is a better policy to maintain a close patrol to discover small fires when they first start than to cut down the expense of the patrol, and then rely upon putting a large force of men on to fight fire after it gets well started. The cost of this association averages about three cents per acre per year, though on account of a very exceptional season it went over that in 1910. The total cost of the Washington Forest Fire Association was 2.3 cents per acre in 1910, and only 1.4 cents in 1909, though much more than the acreage belonging to members was patrolled, in order to better protect their own lands.

Not only do these associations do their own protective work, but they co-operate with the State and National Governments in fire protection. In North Carolina there is a large opening for this feature of their work. The State has at present no fire-fighting force with which to co-operate, but it is hoped that this will be provided for by the next Legislature. The U. S. Department of Agriculture, however, is anxious to spend part of the amount provided for co-operation with States by the Weeks bill in fire protection in North Carolina. It was suggested that the basis of such co-operation might be furnished by a Forest Protective Association working through the State Geological and Economic Survey. It has been decided, however, that this does not come within the meaning of the Act.

There are endless ways in which the activities of such an Association could work for the better protection and consequent enhancement in value of our forests, and the timberland owners of the State are recommended to look thoroughly into this question and, if possible, make trial of this method of protection.

#### STATE MEASURES.

##### *Present Laws.*

In 1777 the General Assembly of North Carolina passed a statute making it unlawful for any one to set fire to the woods, except it be his own property, and in that case not without first giving two days notice in writing to adjoining property owners. After 134 years this law still remains on our statute books, the best and practically the only law we have on the subject. In its present form in The Revisal of 1905 it reads:



3346. *Woods.*—If any person shall set fire to any woods, except it be his own property, or, in that case, without first giving notice in writing to all persons owning lands adjoining to the woodlands intended to be fired, at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands near to or adjoining the lands so fired, he shall, for every such offense, forfeit and pay to any person who shall sue for the same fifty dollars, and be liable to any one injured in an action, and shall moreover be guilty of a misdemeanor.

The law therefore forbids setting fire to woods, even though it be one's own property, without giving two days notice in writing to adjoining landowners. This law is rarely enforced, because the "two days notice in writing" is considered an impractical measure, and also because the strong objection among most people to prosecuting their neighbors acts as a deterrent. One of the most frequent causes of fire, that from burning brush while clearing up new grounds in the spring, is not covered by this law, for the courts have held that these "new ground" fires do not come within the statute. This law is susceptible of considerable improvement and should be amended.

Since the great extension of railroad facilities all over the State, the practice of hauling farm crops and merchandise long distances to market, which used to be the universal custom, has almost ceased. In the rougher and more remote parts of the State, however, where more than one day's trip is required to reach the market the abandoned camp-fire is still a menace. That North Carolina has a law against leaving such fires unextinguished is often not known by wagoners, and a notice quoting the following section posted near frequented camping places would often be of great advantage to the passer-by, as well as a safeguard to the property owner.

3347. *Woods, from Camp Fires.*—If any wagoner or other person encamping in the open air shall leave his camp without totally extinguishing the camp fires, he shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not exceeding fifty dollars, or imprisoned not exceeding thirty days.

These two laws, the most important dating back some 130 years, constitute the present working forest-fire laws of North Carolina. Even these, however, are rarely enforced.

In order to ascertain as nearly as possible to what extent these laws were being carried out, the North Carolina Geological and Economic Survey asked all their forest-fire correspondents the following question: "Has any one, so far as you know, been prosecuted for setting fire to forests in your county or township during the past year? If so, with what result?"



This question was answered in the negative by 195 of the correspondents. Out of the 218 who answered this question usually in one word as "No," "None," or "Nobody," only 23 mentioned any action being taken against those who set out fire, and of these only nine could have been brought under the law against setting fires, the rest being civil suits for damages, chiefly against railroads and lumber companies. The sum total of convictions, for the careless or intentional setting of at least 700 fires in this State during 1910 is four; two in the mountains, in which the parties were "fined light, say \$5 each and costs," and two in the Coastal Plain region, one of whom was let off by paying "good" costs; and the other, to the honor of Pitt County be it said, was given the maximum fine, \$50 and costs. The other suits were, in the words of the correspondents, "Nol prossed," "Compromised, defendant paying \$37.50 damages," "Case before grand jury, but no bill found," "Not a true bill," "Case not yet tried."

The apparent inefficiency of the law is due to the inadequacy of the laws themselves and to the indifference of the people in the matter of burning the woods. This is well illustrated by the following replies from a few of the correspondents in answer to the above question in regard to prosecutions under the fire laws: "Not one. We need more stringent laws as to the careless handling of fire"; "No one. Need more laws"; "Cannot get sufficient proof to get true bill or convict"; "Nobody prosecuted, everybody seems to be afraid to prosecute for fear of being burned out"; "I think not. It would be difficult to convict as it is a 'sport' engaged in by a large percent of our people"; "No; but ought to have been"; "Don't know of any. They are hard to catch and hard to convict in a fence-law territory"; "One was threatened with prosecution"; "No; only for want of officers to enforce the law."

The General Assembly of 1909 passed a law allowing the Governor, at his discretion and on application of the owner, to declare any wooded land which lies above 2,000 feet above sea level a "State forest." The Governor may then, at the request of the owner, appoint such forest wardens as the owner of the land may request, said wardens to have the power of arrest without warrant and to be paid entirely by the owner. For this privilege the landowner pays an annual tax of half a cent per acre into the county treasury for the benefit of the school fund.

No property owner has yet taken advantage of this law, and it is practically a dead letter, the owners probably thinking that the efficiency gained by giving the wardens power of arrest is not worth such a substantial tax.



*Proposed Laws.*

As we have previously seen, the largest number of fires are due to the carelessness or indifference of individuals, and to the negligence of railroads, lumbermen, and other operators of engines. In order to successfully cope with this situation, we need: (1) Better laws to control the private citizen; (2) Stricter regulations controlling the railroad and other engine users; (3) A system maintained by the State, or the State and counties together, to properly enforce the forest-fire laws. These three features may be combined in one act, as was done in the bill which was introduced into the last Legislature, or they may be passed as three separate acts, as is here proposed.

*Fires Set by Private Individuals:*—The present law, which has previously been given, should be amended to include grassland, but the two days written notice required should apply to woods only, or should be eliminated altogether. By broadening the second section to make it include hunters and other persons, some approach to controlling that fertile source of forest fires would be made.

In New Jersey and several other States to the north and west of us, the burning of woods, brush, stumps, rubbish and other material is not allowed during a dry season, and in some cases throughout the year, without a written permit from the proper officer. This has been found to work well in preventing fires, especially the destructive early spring fires. In North Carolina, however, we are hardly ready for such a law. A law to compel all who burn material to watch it till it is extinguished would seem to meet a definite need and would be more easily enforced.

The following suggested bill contains all of the above features:

A BILL TO BE ENTITLED AN ACT TO PROTECT THE FORESTS OF THIS STATE FROM FIRE.

*The General Assembly of North Carolina do enact:*

SECTION 1. That section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five be amended to read as follows: If any person shall set fire to any grassland, brushland or woodland, except it be his own property, or, in that case without first giving notice to all persons owning or in charge of lands adjoining to the land intended to be fired, and also taking care to watch such fire while burning and taking effectual care to extinguish such fire before it shall reach any lands near to or adjoining the land so fired, he shall for every such offense be guilty of a misdemeanor and be fined or imprisoned in the discretion of the court. This shall not prevent action for damages sustained by the owner of any property.

SEC. 2. That section three thousand three hundred and forty-seven of The Revisal of one thousand nine hundred and five be amended to read as follows:



Any wagoner, hunter, camper or other person who shall leave a camp-fire without fully extinguishing it, or who shall accidentally or negligently, by the use of any torch, gun, match or other instrumentality, or in any manner whatever, start any fire upon any grassland, brushland or woodland, without fully extinguishing the same, shall be guilty of a misdemeanor, and upon conviction shall be punishable by a fine of not less than twenty-five dollars nor more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 3. All persons, firms or corporations who shall burn any tar kiln or pit of charcoal or set fire to or burn any brush, grass or other material whereby any property may be endangered or destroyed, shall keep and maintain a careful and competent watchman in charge of said kiln, pit, brush or other material while burning. Any person, firm or corporation violating the provisions of this section shall be guilty of a misdemeanor.

*Railroad Fires.*—The railroads and lumber companies, though great offenders, having caused probably one-third of the fires in the State in 1910, are also great sufferers, being generally held responsible for injury and made to pay damages. A few of the replies to the question asking about prosecutions are here quoted: "Railroad paid for several acres of timber"; "Railroad compromised, nothing done about the rest"; "No; the railroad people always pay damage"; "The railroad has paid about \$1,000"; "No; Railroad Company paid about \$2,000"; "The Railroad Company goes over the ground and sees how much it burns over, and pays about thirty-five cents per acre"; "Set by traction engine, and damage paid"; "Lumber Company sued for \$5,000"; "Lumber Company forced to pay damages"; "Suit entered against one lumber company." These prosecutions are, of course, as said before, brought under the civil law, and do not invoke the present fire laws. They do, however, show that it is as much to the interest of the railroads as to that of the owners of woodland that fires should be prevented. Until there is some general demand, however, that the railroads take necessary precautions, they prefer to drift along in the old way, paying damages now and then,—the average cost of which they know—rather than advocate new laws, which, though they might save them money, still would cost them an unknown amount to carry out. When reasonable laws are once passed the railroads will undoubtedly co-operate actively in their enforcement, trusting thereby to cut down their large annual bill of damages.

During the last session of the Legislature the following bill was drawn up, after careful discussion and criticism of every point by the representatives of the people and of the railroad and lumber companies. It was at first introduced as part of the general forestry bill, but was later drawn up as a separate law. It is in this form that its passage by the next Legislature is strongly urged.



A BILL TO BE ENTITLED AN ACT TO REQUIRE THE RAILROADS OF THE STATE TO TAKE CERTAIN PRECAUTIONS FOR THE PREVENTION OF FOREST FIRES.

*The General Assembly of North Carolina do enact:*

SECTION 1. All persons, firms or corporations operating any railroad, logging road or tramroad through woodland within this State shall keep their right of way cleared of all combustible materials within a horizontal distance of one hundred (100) feet, nowhere to exceed one hundred and fifty (150) feet surface measurement, from the outer rail on each side of the track, by burning or other method. Combustible material, as referred to in this act, shall be construed to mean only such brush, grass, leaves or other material that would ordinarily become ignited from a spark from the engine. When the right of way owned does not extend to the width of the cleared space or fire line herein required, the right is hereby granted to said persons, firms or corporations to enter upon adjoining lands not owned by them, for the purpose of clearing off and maintaining the cleared space or fire line herein required. If any landowner should object to the clearing off and maintenance of the fire line herein required, he shall not be entitled to collect any damages thereafter occurring from fires caused by sparks from the engines of said persons, firms or corporations. Each railroad, logging road or tramroad affected hereby shall be required to clear off each year not more than one-fifth (1-5) of the total length of the fire line required by this section until all has been completed, and shall continue to keep such fire line clear after it has once been cleared off. The part of the mileage to be cleared off by such railroad shall be designated by the Geological Board after conference with the proper officer of such railroad, logging road or tramroad. Any railroad wilfully violating the provisions of this section shall be liable to a penalty of not less than ten (\$10.00) dollars or more than twenty-five (\$25.00) dollars for every mile or fraction thereof of fire line not cleared according to the provisions of this section: *Provided*, that this section shall not be construed to prohibit or prevent any railroad company from piling or keeping upon the right of way, cross-ties or other material necessary in the operation or maintenance of such railroad or materials intended for shipment over such railroad; nor is it intended to require the removal of buildings, fences or other necessary or valuable improvements from the fire line herein required: *Provided further*, that the notice to the adjoining landowners required by section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five shall not apply to any burning necessary to carry out the provisions of this section: *Provided further*, that nothing in this section shall be construed to require the railroad company to clear the fire line on property not owned by said company should the owner object, and no failure on this account shall be charged against the railroad company as a violation of this act.

SEC. 2. When engineers, conductors or trainmen employed by any railroad discover that fences or other material along the right of way or woodland adjacent to the railroad are burning or in danger from fire, they shall report the same promptly at the next telegraph or telephone station at which the train is scheduled to stop, or at any other stops necessary in the operation of the train. The reporting of such fires shall not be construed to mean that the railroad companies making such report are responsible for such fires, nor shall such report be used in evidence in a suit arising from such fire, but is simply for the purpose of giving information as to the existence of a fire. In seasons of drought the rail-



road companies shall give instructions to their section foremen for the prevention and prompt extinguishing of fires originating on their right of way, and they shall cause warning placards, furnished by the Geological Board, to be posted at their stations in the vicinity of forest lands. Any railroad company wilfully violating the requirements of this section shall be guilty of a misdemeanor, and railroad employees wilfully violating the requirements of this section shall be guilty of a misdemeanor.

SEC. 3. For the purpose of this act woodland is taken to include all forest areas, both timber land and cut-over land, and all second growth stands on areas that have at one time been cultivated.

This law requires the railroads to clear off a strip 100 feet wide on each side of their track, where it runs through woodland. It has been demonstrated after careful study that most of the live sparks from railroad locomotives fall within the zone between 50 and 100 feet on each side of the track, and very few fall beyond that distance. Keeping this strip clear would then prevent most of the fires caused by railroads and logging roads, which, as we have seen above, constitute about one-third of the fires in the State.

*Fire Warden System.*—The most important problem in the formulation of forest laws is providing effective machinery for putting them into force. Eighteen States have already organized fire protective systems, the purpose of which is to enforce the forest-fire laws of these States. Little or nothing has been accomplished in States without such systems, though several, like our own, have some excellent laws. A fire warden system generally consists of district, township, or county wardens, who, as a rule, are responsible to some one State official, either the State Forester, the State Forest Commissioner, or State Fire Warden, who is specifically charged with fire-protective work and usually also with the forestry work of the State. It is the duty of the wardens to extinguish fires, arrest offenders against the fire laws, investigate the causes of fires, post warning notices against fire and in some cases to patrol the forests during dry weather. They are paid by the State, or by the county, or by the State and county combined, usually by the hour or day, for the time actually employed. In fixing a rate of payment, care is taken not to make it high enough to tempt unscrupulous men to set fire to the woods with the object of drawing pay for extinguishing it. This practice may, of course, be occasionally resorted to, even where the pay is not high, but an efficient county fire warden would soon discover the perpetrators or at least have his suspicions aroused, and one or two drastic sentences, upon conviction, would put a stop to the practice. There are many counties in North Carolina where fire wardens are not



needed, but in counties having fifty per cent and over of their area in woodland they would quickly pay for their cost. If only a few counties were given the advantage of such a law to start with, the demand for fire wardens would rapidly spread, as their usefulness became apparent. The following bill, in a somewhat different form, was introduced into the Legislature of 1911, but failed to pass, chiefly because a special tax of half a cent per acre on all woodlands in the State was asked, to provide revenue for its enforcement. This method of raising the necessary money is perfectly fair and equitable, but until the system can be inaugurated and tested in those counties that most need fire protection, it is thought that a direct appropriation would be much simpler and more practicable.

A BILL TO BE ENTITLED AN ACT TO AUTHORIZE THE APPOINTMENT AND PAYMENT OF FOREST WARDENS.

*The General Assembly of North Carolina do enact:*

SECTION 1. On petition of four or more owners of timber lands in any one township, owning in the aggregate five thousand acres or more, or the owners of one-third of the forest land in the township, the county commissioners shall appoint, subject to the approval of the Geological Board, a forest warden for that township and as many deputy forest wardens to act with him as the Geological Board may deem necessary for the proper enforcement of this act. All forest wardens and deputy forest wardens must be legal residents of the counties in which they are employed.

SEC. 2. Forest wardens and deputy forest wardens shall have charge of measures for controlling forest fires; they shall make arrests for violations of the forest laws; shall post along highways and in other conspicuous places copies of the forest fire laws and warnings against fires which shall be supplied by the Geological Board; and they shall perform such other duties as shall be considered necessary by the Geological Board for the protection of forests. The forest wardens of the township in which a fire occurs shall within ten days make such report thereof to the Geological Board as may be prescribed by them. Each deputy forest warden shall promptly report to wardens any fire in his district.

SEC. 3. Any person who shall maliciously or wilfully destroy, deface, remove or disfigure any sign, poster or warning notice, posted by order of the Geological Board under the provisions of this or other act for the purpose of protecting the forests in this State from fire, shall be guilty of a misdemeanor and upon conviction shall be punishable by a fine of not less than ten dollars or more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 4. Any person discovering any forest fire shall immediately give notice to the nearest forest warden or deputy forest warden in that or adjoining townships. All able-bodied male persons between eighteen and forty-five years of age can be summoned by forest wardens or deputy forest wardens to assist in extinguishing forest fires and shall be paid for such services at a rate not to exceed fifteen (15) cents per hour. Any person summoned by a forest warden or his deputy and not attending, without reasonable excuse, shall be subject to a fine of five (\$5) dollars.



SEC. 5. Forest wardens and deputy forest wardens shall have the same power as deputy sheriffs, so far as the provisions of this act are concerned. Neither forest wardens nor their deputies shall be liable for trespass while acting in the performance of their duties, nor shall any person be held guilty of trespass for going on lands when summoned by an officer to control fire.

SEC. 6. Forest wardens and deputy forest wardens shall receive compensation from the State at the rate of twenty cents per hour for the time actually engaged in the performance of their duties and reasonable expenses for equipment and transportation incurred in fighting or extinguishing any fire, according to an itemized statement to be rendered the Geological Board every month and approved by them. Forest wardens shall render to the Geological Board a statement of the services rendered by the men employed by them or their deputy wardens, as provided in this act, within one month of the date of service, which said bill shall show in detail the amount and character of the service performed, the exact duration thereof, the name of each person employed, and any other information required by the Geological Board. If said bill be duly approved, it shall be paid by direction of the Geological Board out of the State Treasury; and the State Treasurer is hereby authorized and required to collect one-half of the wages and expenses incurred by the forest wardens and deputy forest wardens under this section and section three (3) of this act, from the county in which they are incurred.

SEC. 7. The sum of ten thousand dollars annually is hereby appropriated, out of any moneys in the treasury not otherwise appropriated, for the purpose of carrying out the provisions of this act, the same to be drawn upon as directed by the Geological Board.

#### NATIONAL MEASURES.

*Co-operation Under the Weeks Bill:*—With the recent passage by Congress of the Weeks Bill (Pub. No. 435) "to enable any State to co-operate with any other State or with the United States for the protection of the watersheds of navigable streams, etc." an opportunity has been opened to secure fire protection, for at least the mountain portion of the State, at one-half the actual cost of such protection. This bill provides, among other things, as follows:

SEC. 2. That the sum of two hundred thousand dollars is hereby appropriated and made available until expended, out of any moneys in the national treasury not otherwise appropriated, to enable the Secretary of Agriculture to co-operate with any State or group of States, when requested to do so, in the protection from fire of the forested watersheds of navigable streams; and the Secretary of Agriculture is hereby authorized, and on such conditions as he deems wise, to stipulate and agree with any State or group of States to co-operate in the organization and maintenance of a system of fire protection on any private or State forest lands within such State or States and situated upon the watershed of a navigable river: *Provided*, that no such stipulation or agreement shall be made with any State which has not provided by law for a system of forest fire protection: *Provided further*, that in no case shall the amount expended in any State exceed in any fiscal year the amount appropriated by that State for the same purpose during the same fiscal year.



Under this law the Federal Government is empowered to co-operate with the various States in the organization, direction, and extension of a fire protective system, by putting in a sum of money equal to that appropriated by the State for this purpose. It can, however, only co-operate with States which have some form of State fire protection already. North Carolina has no such system, and though the Federal officials have showed a strong desire to spend part of this money in this State, nothing can be done to take advantage of this proffered co-operation until a regular State system of fire protection can be established. Should the Legislature in 1913 pass a law like that suggested on pages 32-33, appropriating \$10,000 for fire protection, an equal sum might, under the Weeks law, be procured from the Federal Government, making \$20,000, with which a good start could be made towards the prevention of forest fires in North Carolina.

Owners of forest land should make every effort to take advantage of this great opportunity by seeing to it that men actively in favor of forest protection are nominated and elected to the next General Assembly.

#### EDUCATIONAL MEASURES.

The majority of our people have been raised where there was always abundance of wood for fuel and for other local necessities, and where the selling of timber off the land has been looked upon as something extra made over the ordinary income. Timber has never been rated at its true value, namely, its cost value to grow, because there has been abundance of timber ready grown to our hand. It is not strange then that there is so much indifference to the growing necessity of fire protection. Economic conditions have been changing so rapidly of late years that it is only those who are in close touch with the markets of the country and who are studying the progress of events that realize the necessity for conservation of our forests.

A campaign of education along these lines must be carried on all over the State, not only to show the property owners themselves and the other grown citizens that it is to their interest and that of their children to protect and perpetuate the forests; but also and probably chiefly, to educate the children, to bring them up to realize that a new condition exists, and that the trees and the forests are really growing crops, and very necessary and valuable crops, and that as such they require care and attention as much as any farm crop.

The children of today are the property owners and lawmakers of tomorrow, so while we do not cease to advocate forest protection amongst the present-day citizens, let us at the same time train our future citizens to appreciate its necessity.



## ARBOR DAY.

Probably the best and most attractive as well as the most practical way just at present, to inculcate a knowledge and love of trees among even the smallest children, is to make the observance of Arbor Day an annual feature in all the schools of the State. This would reach all of the children of the State once each year and would give them information in a form in which it would be remembered.

Few children, or grown people either for that matter, can distinguish a longleaf from a shortleaf pine seedling, know the conditions most favorable for the best growth of even our commonest forest trees, or can tell one oak or one pine from another by the bark, the buds, the leaves or the fruit.

In order to foster a love of trees among children and to teach them elementary facts about them, as well as to encourage the planting of trees and the intelligent care of forests by their elders, the practice of observing Arbor Day has been introduced into nearly every State in the Union, and in many States it is a legal school festival. In North Carolina the day was observed as far back as 1893, but unfortunately it has never received general recognition. Only a school here and there has observed the day with appropriate exercises, when some of the teachers or patrons have been especially interested in the subject.

In 1896 the School Committee of the town of Durham passed a law providing:

SECTION 1. That the second Friday in April of each year shall hereafter be known in the Durham Public Schools as Arbor Day.

SEC. 2. In order that the children in our public schools shall assist in the work of adorning the school grounds with trees, shrubs and flowers, to develop and stimulate a love and reverence for nature, to inculcate economic and æsthetic purposes which will result in beautifying the home and increasing the comfort and happiness of our people, it shall be the duty of the Superintendent of Schools to provide for and conduct such exercises as shall best accomplish these results.

An Arbor Day program was prepared and published in a twelve-page leaflet. This program, as carried out on April 10, 1896, is here given, by headings, in order to convey to those who have never attended such a celebration some idea of how attractively it may be carried out.

## DURHAM PUBLIC SCHOOLS.

## ARBOR DAY.

ASSEMBLY HALL, APRIL 10, 1896.

1. Music .....Orchestra
2. Arbor Day Song.
3. Responsive Exercises (in the words of Scripture).

4. Prayer (to be recited in concert).
5. Music .....Orchestra
6. Class Exercise, Telling About Arbor Day.
  - (a) What is Arbor Day?
  - (b) Tell something of the origin of Arbor Day.
  - (c) Why do we observe Arbor Day?
  - (d) Why do you name your trees for some celebrated person?
  - (e) How are books and trees related?
  - (f) Tell me something about tree religion.
  - (g) What about trees as living things?
  - (h) Why should the forests be preserved?
  - (i) What do we get from the forests?
  - (j) You haven't told me anything about flowers.
  - (k) What trees do you think the best for school grounds?
  - (l) Tell me how to plant a tree, size, etc.
7. Some Things said About Observing Arbor Day.
8. Song of Dedication.
9. Reading—The Tree of the Field is Man's Life.
10. Reading—The Talk of a Tree.
11. Music .....Orchestra
12. Recitation—Selections from Bryant, Irving, Emerson, and others.
13. Recitation—Resolution Protesting Against the Destruction of Trees.
14. Exercise—The Arbor Day Queen.
15. Reading Letters About Arbor Day from Distinguished North Carolinians.
16. Recitation—The Woodman and the Tree.
17. Music .....Orchestra
18. Song—The Chorus of the Flowers.
19. Acrostic—Arbor Day.
20. Song—Love of Nature.
21. March—Washington Post.
22. Exercises at the Tree.
 

*(Pupils from each schoolroom march to the school grounds, five of the class carrying spades, the handles being decorated with school colors—white and orange—and form a circle around the spot where the tree is to be planted.)*

  - (a) Placing the tree in position.
  - (b) Tree planting Song.
  - (c) A brief statement by the teacher concerning the person to whom the tree is dedicated.
  - (d) Recital of quotations from writings of persons thus honored.
  - (e) Pupils place the soil around the tree with their spades.
  - (f) March to class room.

Recently the Forester of the North Carolina Geological and Economic Survey was invited to make an address at an Arbor Day celebration at Southern Pines, in which the whole town took a gratifying interest. The Civic Club, an organization of the women of the place, was the prime mover, while the teachers and the school children united with the club to make the occasion a great success. Trees and shrubs were



planted on the school grounds in the morning and in the afternoon drills, songs, and recitations, illustrating the child's relation to the trees and flowers around him, were very well given by the children in the large school auditorium.

Such a celebration might be held annually by every school in the state with great profit to the children, and with increasing interest on the part of the parents. There is a growing tendency among the men to leave the education of the children more and more to the women, and the next generation will have special cause to bless their mothers for opening their eyes to the beauty and usefulness of the trees if the women, who, through their clubs are doing such good work for civic improvement and the betterment of education, would take up this matter all over the State and work for a general Arbor Day observance.

In most States some special day is selected as Arbor Day by the Governor or Superintendent of Education, or some other authority, and all schools are expected to observe that particular day. In North Carolina, where the school year varies so in the different counties, and where the time for planting trees varies with the different regions of the State, it would probably be better for each County Superintendent, or even each School Principal, to set the day which would be most convenient to him and most appropriate to the season and locality. Where only a summer and fall school session is given, October in the mountains, November in the Piedmont section, and December in the eastern part of the State would be suitable times, while where a nine or ten months school is the rule, March or April would be more suitable, as children, and older folks too, for that matter, naturally turn to the woods and fields in the spring-time. Some Friday would usually be selected as interfering less with the routine of school work, though such interference really often turns out to be rather a help than hindrance to the work.

#### FORESTRY IN THE PUBLIC SCHOOLS.

There are two ways in which Forestry can be taught in the Public Schools without adding another course to the already crowded curriculum: first, by means of an auxiliary reader; and second, by correlating the various phases of Forestry with those courses taught in the school which are naturally connected with it.

1. The present system in North Carolina requires the use of "basal" readers in the various grades. These are supplemented by auxiliary readers on a great variety of subjects, such as: geography, household economics, etc. The use of these is optional, the County Superintendent or the Principal deciding on the subject which will be most helpful



to each particular class. So far there is no auxiliary reader on the subject of Forestry, or even on the more general and comprehensive subject of Conservation. There is room for a book of this character, and it is to be hoped that one will shortly be provided. Such a book should set forth in simple language the fundamental principles of Conservation and then show how these are related to the economics of everyday life.

2. In his circular "Forestry in the Public Schools" (Circular 130, Forest Service, U. S. Department of Agriculture), Prof. Hugo A. Winkenwerder advocates and outlines plans for the study of Forestry in connection with studies which are already being taught. He states that the object of this circular is to indicate to teachers who are interested the courses in which Forestry deserves a place and to assist them in choosing the proper subject-matter. A description of the location, extent, and character of the forests of the locality in which the teaching is done, of the State, and of the country as a whole, should form part of the study of geography as taught in all the common or secondary schools of North Carolina. Their economic value as sources of useful products, for conservation of water, for protection, and their influence on erosion and soil protection, as well as their æsthetic value, should be brought out as well as the necessity of forest protection, especially for protecting them from fire. Nature study, where it is taught, opens the way for some elementary forestry; in fact, the study of the trees, the shrubs, and the seedlings found in the woods is the most attractive form of nature study, and develops very rapidly the habit of observation, which is the chief object aimed at in all such training.\*

In the High Schools, along with United States History, can be taught the importance of the forests to our development, the growth of the forestry movement, and of the National Forest Policy. The protection of forest property and the policies relating to public lands should form a part of the course in Civics. A course in physical geography is not complete without considering the relation of forests to climate; the influence of forests upon water and soil conditions; the relation of forests to erosion, and to reclamation. Commercial geography must include the importance of forests as a national resource, the distribution of forests, the products of the forest and the influence of forestry on commerce. It is impossible to enumerate the opportunities which the forest offers to teachers of botany.

In the farm-life schools and others of a similar nature practical forestry should be one of the important studies, and the school-farm should

\*A special circular, "Forestry in Nature Study," issued by the U. S. Department of Agriculture, gives outlines of instruction in this subject for all terms and grades in the public schools.



furnish sufficient area in woods to give practical work in forest management. Nearly all North Carolina farms contain a large proportion of woodland, and it is as important for farmers to know how the yield may be increased on this as on the cleared land.

#### FORESTRY IN THE COLLEGES.

In order to bring this important problem before the young men who are yearly leaving our higher institutions of learning to take part in the management of the State, courses in Forestry should be given in all our colleges and in the State University. Complete courses are not required, but enough should be taught to give the students some idea of the forest problems that confront us and the best way to deal with them. In the A. & M. Colleges more complete instruction should be given; courses calculated to give the student a knowledge of how to manage a wood-lot, how to measure and sell standing timber and log it if necessary, how to protect the forest from fire and insects, what trees to plant and how, when, and where they should be planted. According to the President of the A. & M. College, who would be glad to add a course in Forestry to the curriculum, only one additional man would be required for this purpose. The same is true of the State University. Courses in Botany, Entomology, and Engineering are now given at both institutions. By adapting such courses to the needs of the forester and then founding a Chair of Forestry proper, which would include silviculture, forest management, and lumbering, an excellent course in Forestry could be given. Funds for the foundation of such a chair, however, are not available at either place, and probably will not be until a more general demand for such a course is made. The timber crop is second only in importance to the cotton crop in North Carolina, and most farmers have a larger acreage in woodland than in all other crops combined. It seems, therefore, that more recognition should be given this subject in our State Agricultural College, as well as in the State University.

#### LECTURES AT FARMERS' INSTITUTES, ETC.

It is not only through the Farm Schools and the A. & M. College that the State is trying to teach the farmer improved methods. For several years past it has been sending experts to all the counties of the State to lecture on improved methods of farming, from soil improvement to poultry-keeping. The timber crop is the only subject that has been entirely omitted from the list of subjects discussed. A talk on forest management or forest protection should be included in every program, for the subject is of the greatest importance to most farmers. Latterly the



Forester of the North Carolina Geological and Economic Survey has joined one of the parties in the western part of the State for a short time each summer and talked to the meetings on this subject, but this is only a very small beginning. An extension of this work all over the State is strongly advocated.

But lecture-work need not be confined to the colleges and the farmers' institutes. Addresses should be made all over the State as opportunity offers, and forest protection advocated before all kinds of audiences. Not till the people begin to think about the subject will they realize the importance of immediate action.

#### FORESTRY ASSOCIATIONS.

On February 1, 1911, a Forestry Convention met in Raleigh for the purpose of discussing proposed forestry legislation. Though the attendance was not large it was quite representative. Delegates from eighteen counties of North Carolina were present, including lumbermen, furniture manufacturers, railroad men, timberland owners, farmers, foresters and educators. The forestry bills then before the Legislature were discussed in detail, and much interest was shown in them, as well as in a State-wide stock law. A new forestry bill was drawn up at the meeting, which it was recommended be substituted for the two already introduced. This bill, which combined all the features in the three laws suggested on pages 28, 30, and 32, was later introduced in both houses, but failed to pass. The following resolutions were adopted by the convention:

WHEREAS, It has been estimated that there is in North Carolina sufficient forest land to maintain perpetually a supply of raw material for our furniture factories, our pulp mills, and our tanning extract plants, if these forests are conserved and protected from fire; and,

WHEREAS, The forests of North Carolina and the industries dependent upon them represent about one-sixth of the wealth of North Carolina; and,

WHEREAS, These forests are being devastated by frequent fires, causing enormous present and future loss to the owners of forest land and indirectly to the people throughout the whole State; therefore,

*Be it resolved*, That we thoroughly endorse legislation that will protect our forests from fire, and urge the General Assembly to pass such measures as will enable those portions of the State that desire it, adequate fire protection for their forests; and as the best results can only be obtained when the stock law is in force,

*Be it further resolved*, That we endorse a State-wide stock law for North Carolina, with a provision allowing any territory voting for that purpose to be exempted therefrom upon erecting proper fence around such exempted territory.

*Be it further resolved*, That we advocate the teaching of the principles of forestry in the public schools and the introduction of a course in forestry in the A. & M. College.



Such a meeting as this is calculated to do a great deal to advance the cause of forest protection by awakening interest in the question and by unifying effort. With these ends in view it was unanimously decided to organize the convention into a permanent body to be known as the North Carolina Forestry Association, this association to have a President, Secretary-treasurer, and one Vice-President for every Senatorial District in the State in which sufficient interest in forestry had been manifested. The work of the Association was placed in the hands of an Executive Committee, consisting of the President, Secretary-treasurer, and five other members, to be appointed the first year by the president of the Association. The object and aim of the association was declared to be "the protection and perpetuation of the forests of North Carolina." Dr. D. H. Hill, of the A. & M. College, Raleigh, was elected President of the Association, and Mr. J. S. Holmes, Forester of the North Carolina Geological and Economic Survey, Chapel Hill, Secretary-treasurer. The President subsequently appointed the following gentlemen as members of the Executive Committee: Col. B. Cameron, Raleigh; Mr. Clarence Poe, editor *Progressive Farmer*, Raleigh; Dr. J. H. Pratt, State Geologist, Chapel Hill; Mr. H. M. Shaw, president Southern Wheel Company, Oxford; and Mr. E. B. Wright, manager Butter's Lumber Company, Boardman, N. C. The very fact that such prominent men are behind this movement speaks well for its future success and usefulness, and also inspires the confidence of the public in any recommendations it may make.

The organization of county or district associations, in connection with this State Association, to stir up and direct local sentiment, would do more to make the society effective and to forward the forestry movement than any other kind of work that could be undertaken. The good roads movement has received its greatest impetus from town and county good roads associations, though the State organizations have done splendid work. In the same way local forestry clubs, societies, or associations, or forestry branches of other bodies, acting in accord with the State Association, may do a great work in educating the people to a realization of the importance of forest protection. There are forestry sections of several of the women's clubs in the State that are doing good educational work, and the number might, with advantage, be increased. Different phases of forestry will appeal to different organizations; street planting to civic clubs, protection of watersheds and regulation of stream flow to Chambers of Commerce and Boards of Trade, perpetuation of the timber supply to labor organizations and lumbermen, the management of the wood-lot to Farmers' Clubs; but protection of the forests from fire should appeal to all.



## DEMONSTRATION FORESTS.

One method of educating the public in improved methods of forest management which is widely practiced in Europe and has been adopted by several of the northern States is by the proper management of State Forests. In different parts of the State areas of land of larger or smaller extent are acquired by gift or purchase, or reserved by the State for the purpose of demonstrating the most practical form of management for that particular locality and for that kind of forest, and on which to conduct experiments to determine practical questions in forest management. In many cases land is given or bequeathed to the State by public-spirited citizens for this purpose.

If the people can be shown the results of proper treatment of the forests in successful fire protection, conservative lumbering, profitable tree planting, and advantageous thinnings, more would be accomplished than by countless lectures and bulletins. On an area in the high mountains experiments might be made to determine the best way to cut spruce for pulp while insuring the perpetuation of these forests. In the mountain hardwood forests methods to increase the proportion of popular, chestnut, and other valuable species in the second growth might be demonstrated. In the Piedmont region the profits in judicious thinning of shortleaf pine stands could be shown. In the Coastal Plain region successful reproduction of longleaf pine might be demonstrated and experiments made to determine whether longleaf or loblolly pine was the most profitable tree to grow on certain types of soil. On "the Banks" the fixation of drifting sand by forest growth could be shown by planting up the sand dunes, and the profitable use of such areas made apparent by propagation of turpentine yielding pines. All such demonstrations, besides their value for experiments and for showing improved methods of forest management, involve, of necessity, adequate fire protection, and the successful accomplishment of this alone would make the acquirement and management of such demonstration forests justifiable, and fully compensate the State for their cost.

## CONCLUSION.

Reports from correspondents in but one-third of the townships of the State give an estimated area of 580,000 acres of woodland burnt over during 1910, with a consequent loss of over half a million dollars in timber and personal property. If the losses from this cause in the remaining townships could be ascertained, and the enormous damage to young growth, soil and streams could be computed, it is very certain that the total loss to North Carolina by forest fires for the past year



would reach a million dollars. Not only this, but a loss of five human lives was caused directly by these same fires, which were in large part due to carelessness, and might and should have been prevented.

In 1909 the damage from forest fires amounted to several hundred thousand dollars, and every year it is much the same, and will continue to be the same until North Carolinians wake up and take some active steps to stop this destruction.

There is pressing need for more effective laws to protect the forests from fires resulting both from the railroads and from individuals. Such laws when enacted must have the support of the people, or they can not be efficiently enforced. What is needed in this as in other lines of business is education. The timber crop is second only in importance to the cotton crop in North Carolina, and occupies ten times the acreage of that staple, yet there is not one school or college in the State in which even elementary forestry is taught. Is it any wonder that the people show such indifference to forest destruction? A more general interest in forest protection must be aroused and more definite knowledge of practical forestry methods imparted to both the young and the older citizens of the State, and this can best be done by teaching the principle of forestry in our schools and colleges.





**PUBLICATIONS**  
OF THE  
**NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY**

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp. 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp. 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Waterpowers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895, 8°, 47 pp., 5 pl., *Postage 4 cents.*
10. Gold Mining in North Carolina and Other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Waterpowers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report of the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp. 22 pl., 5 figs. *Postage 15 cents.*



## ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Tale and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Tale, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.



15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. Forest Fires and their Prevention, Including Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Postage 5 cents.*

## VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Physiography and Geography of the Coastal Plain Region of North Carolina. *In Press.*

## BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

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Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

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Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract; Buncombe County, Transylvania County State Farm, certain Watersheds, Reforestation of Cut-over and Abandoned Farm Lands, on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

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Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE EXAMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

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THE NORTH CAROLINA GEOLOGICAL AND  
ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

ECONOMIC PAPER No. 23

THE MINING INDUSTRY

IN

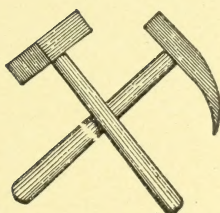
NORTH CAROLINA DURING 1908, 1909 and 1910

BY

JOSEPH HYDE PRATT, Ph.D.

AND

MISS H. M. BERRY



RALEIGH

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## LETTER OF TRANSMITTAL.

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CHAPEL HILL, N. C., November 15, 1911.

*To His Excellency, HON. W. W. KITCHIN,*  
*Governor of North Carolina.*

SIR:—I herewith have the honor to submit for publication as Economic Paper No. 23, a Report on the Mining Industry in North Carolina for the years 1908, 1909, and 1910.

Yours respectfully,

JOSEPH HYDE PRATT,  
*State Geologist.*





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## PREFACE.

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The very long delay in the publication of the report on the Mining Industry for 1907 is the reason why the statistics for 1908 and 1909 were not given in separate reports, when collected.

In order, however, that the statistics of the production of the various minerals might be available, Press Bulletins were published in 1909 and 1910, giving these statistics for the previous years.

The statistics for all minerals, except gold, silver, and copper, have been collected in coöperation with the United States Geological Survey. The figures for gold, silver, and copper, however, have been obtained mainly by statistic cards sent out by the State Survey and through information courteously given by Mr. Frank Drane, of the United States Assay office at Charlotte. The Survey wishes to express its appreciation to all the mineral producers of the State who have so courteously and generously assisted in making the compilation of this report possible.

JOSEPH HYDE PRATT,  
*State Geologist.*



# MINING INDUSTRY IN NORTH CAROLINA DURING 1908, 1909, AND 1910.\*

By JOSEPH HYDE PRATT AND MISS H. M. BERRY.

## INTRODUCTION.

The financial panic and general business depression which was felt all over the country during the latter part of the year 1907 had a very marked influence on the mineral production in North Carolina for the succeeding years, and the value of the mineral production for 1908 was nearly a million dollars less than for 1907. There has, however, been a steady increase since 1908, and, in the year 1910, the value of the mineral production of North Carolina almost regained the figures of 1907.

Of the metallic minerals, iron holds first place in the table of production and gold and silver next. The panic of 1907 caused the price of copper to decline very markedly, and in 1908 very little copper ore was sold. The 1909 production was considerably more than in 1908, but in 1910 the copper production again declined, due to the low price of this metal.

Of the non-metallic minerals, clay products, building stones, mica, and talc are prominent in their production in the order named. There has been a considerable decrease in the production of monazite owing to the fact that thorium salts are imported cheaper than they can be produced in this country.

On the whole it will be seen that the mining and quarrying industries of the State regained in a great measure the loss sustained from the financial panic of 1907, as was evidenced in the production of 1908, and it is believed that in 1911 the mineral production will regain, if not surpass, that of any previous year.

There is given in the table below the production of each mineral produced in North Carolina from 1906 to 1910, inclusive; where there were less than three producers, the mineral is included under "Miscellaneous."

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\*The statistics given in this report with the exception of those for gold, silver, and copper were collected by the State Survey in cooperation with the U. S. Geological Survey.

THE MINERAL PRODUCTION IN NORTH CAROLINA FOR THE YEARS 1906-1910,  
INCLUSIVE.

Mineral	1906	1907	1908	1909	1910
Gold.....	\$ 122,008	\$ 82,195	\$ 97,495	\$ 43,075	\$ 68,586
Silver.....	30,944	14,299	668	324	4,888
Copper.....	135,829	116,416	2,560	29,186	17,845
Iron.....	75,638	113,488	76,877	107,013	114,237
Pyrite.....					
Garnet.....					
Corundum.....		13,500		9,188	7,981
Millstones.....	4,110	1,969	4,052		
Mica { Sheet.....	205,756	209,956	114,540	122,246	193,223
Scrap.....	11,940	15,250	13,330	26,178	37,237
Quartz.....	12,578	1,664			
Precious stones.....	5,000	7,580	570	479	700
Rare minerals.....		9,300			
Monazite.....	125,510	54,824	37,224	46,928	10,104
Zircon.....	248	46		250	
Barytes.....	10,020	18,855	*	*	*
Talc and pyrophyllite.....	66,979	74,347	51,443	77,983	69,805
Mineral waters.....	31,413	40,302	27,163	20,558	21,389
Graphite.....	475				
Coal.....					
Stone.....	854,301	956,919	824,927	850,807	920,027
Sand and gravel.....	9,191	2,191	2,070	13,358	13,406
Sand-lime brick.....	32,975	38,808	*	*	*
Kaolin.....	90,036	85,505	*	*	*
Clay products.....	1,182,660	1,316,303	944,317	1,302,611	1,223,704
Miscellaneous.....			109,880	133,642	145,314
Total value.....	\$ 3,007,601	\$ 3,173,722	\$ 2,307,116	\$ 2,783,826	\$ 2,848,446

The following minerals and ores have been mined in North Carolina during the past three years and are taken up in this report in the order given: Gold and Silver; Copper; Iron; Tin; Abrasive Materials (including Garnet and Millstones); Mica; Quartz (Flint); Barytes; Monazite and Zircon; Talc and Soapstone; Precious Stones; Mineral Waters; Graphite, Coal; Peat; Stone (including Granite, Sandstone, Marble, and Limestone); Sand and Gravel; Sand-lime Brick; Kaolin and Clay Products.

#### GOLD AND SILVER.\*\*

In the Mining Industry for 1906 a rather extensive report was made on the gold and silver deposits of the State, and, in the Mining Industry for 1907, some further details were given.

Some of the gold produced in North Carolina is obtained from placer deposits and some as a by-product in monazite mining; but the greater portion is obtained from deep mining.

Mr. H. D. McCaskey in his report† for 1908 gives the following review of the gold and silver mining industry in North Carolina by counties:

*Anson, Ashe, Buncombe Counties.*—There was no production in 1908 reported from Anson, Ashe, and Buncombe counties.

*Burke County.*—In Burke County there was a small production of placer gold from several operators. The surface veins and gravels of the Mills mine were worked by the hydraulic method and produced both gold and crude monazite.

\* Included under "Miscellaneous."

\*\* See also Bulls. 3 and 10, and Economic Papers, No. 14, pp. 19-70, and No. 15, pp. 12-19.

† Advance chapter from Mineral Resources of the United States, 1903, on Gold, Silver, Copper, Lead, and Zinc in the Eastern States, pp. 23-26.



*Cabarrus County.*—In Cabarrus County the Linker mine was idle in 1908, but there were a number of other producers, notably the Meadow Creek and New Nugget placer mines, from which a considerable production of gold, partly in nuggets, was obtained. There was also a small output of gold and silver, resulting from the working of the old dumps of the Phoenix mine.

*Caldwell County.*—From Caldwell County there was no production reported in 1908.

*Catawba County.*—In Catawba County the England, Peach Tree and Shuford mines all produced small outputs of gold and silver during the year. The Catawba Gold Mining Company, operating the Shuford mine, continued trials of machinery preparatory to the erection of a plant for treatment at a low cost of surface ores. The method of handling will include cable tramway, clam-shell excavator, trommels, crushers, rolls, riffles, and blankets.

*Cleveland County.*—In Cleveland County there was a small recovery of placer gold by the Carolinas Monazite Company after the concentration of monazite sands.

*Davidson County.*—In Davidson County both the Silver Valley and the Silver Hill mines were idle in 1908. The latter mine is one of the oldest and deepest in the State, and, with the Silver Valley mine, 5 miles to the northeast, has furnished the chief supply of lead-zinc ores of North Carolina. The ores are gold and silver bearing galena and blends, with smaller quantities of pyrite and chalcoppyrite, and the country rock is of schist.\* The gossan was worked in the early days only for gold. The Emmons and Cid mines, of the Hercules Gold and Copper Company, were also idle in 1908. The former has been a producer of copper ores in recent years, and the company will probably resume operations. The Welborn mine did not produce in 1908.

*Davie County.*—The Gray mine, near Statesville, in Davie County, was operated for a short time only during the year, and no production was reported. The ore is wholly refractory.

*Franklin County.*—In Franklin County the production from the Portis mine was small, work upon this property having been confined to prospecting and development.

*Gaston County.*—In Gaston County a small production resulted from the reworking of ore dumps of the old King's Mountain mine and from other surface operations.

*Guilford County.*—In Guilford County the Deep River, Fentress, Oak Hill, Palachian, and Pine Hill mines were also idle, but there was a small output from the Hudson mine, near High Point.

*Jackson County.*—There was no production reported from any of the gold and copper prospects in Jackson County in 1908, but there was some development work done at the Cullowhee copper mine, and a 30-ton smelter and a 10-ton lixiviation plant were reported in course of erection.

*Macon County.*—There was no production reported from Macon County. Some prospecting is, however, reported to have been in progress, which showed the presence of both gold and silver ores.

*McDowell County.*—In McDowell County there was a small output of placer gold.

*Mecklenburg County.*—There was but little activity among the many old mines and prospects of Mecklenburg County during the year. A considerable amount of prospecting was done by the Southern Placer Mining Company, and there was a small production from the Catawba River dredge, the Yellow Dog mine, and from ores of the St. Catherine-Rudisil group near Charlotte, which were sent to the Haile plant for trial; but the Capps, Frederick, Grier, Johnson, and Surface Hill mines were idle practically throughout the year.

*Montgomery County.*—A small quantity of placer gold, chiefly as nuggets, came from surface mines, but the main production of gold from Montgomery

\*Kerr, W. C., and Hanna, George B., *Geology of North Carolina*, vol. II, Pt. II, North Carolina Geol. Survey, 1888, pp. 193-199.

County, and from North Carolina, was derived, as usual, from the Iola mine. This property, the second largest producer of gold in recent years of the Appalachian States, is near Candor, and along the line of strike of the Montgomery and Golconda veins. Although one of the newest mines in the State, having been worked for only about eight years, the production in gold from this mine is already considerably over \$300,000, a respectable showing in the Eastern States. The mine has been most recently described by Hafer\* and Lyon.\*\* The development has been mainly by 4 shafts and 5 levels, and the plant for treating the ore has been gradually increased until a 40-stamp mill, with concentrators and a 40-ton cyanide capacity, have been reached. The country rock has been described as a "greenstone of slaty character, probably a sheared andesite," by Lyon, and the vein from 2 to 6 feet wide seems to have been quartz at the surface, but a "slaty quartzite ore carrying some lime spar" in depth. The gold has been found free for the greater part in the vein, but the walls are impregnated with pyrite. The ore has been found in shoots and seems to have been particularly profitable near the surface, although Lyon states that in the two lowest levels, 255 and 327 feet deep, north and south from the No. 1 shaft, the richest ore in the mine has been found. The company recently underwent reorganization, but the output reported for 1908 was somewhat higher than in the two preceding years.

*Moore County.*—The Laufman mine and the properties of the Elise Mining Company, near Hemp, in Moore County, were not operated during 1908, and there was no production reported by the Argo Mining Company from their Nash County mines.

*Orange County.*—In Orange County, however, the Robertson mine, of the North State Mining Company, made a small output from the 10-stamp concentrating mill. The development work, begun in June, 1908, included a shaft 120 feet deep and 350 feet of drifts. The mill was only started up at the close of the year.

*Person and Polk Counties.*—In Person County little was done in the Durgy and other mines of the Virgilina mining district; and in Polk County the Red Springs and Weatherby mines were idle, the production being confined to a small quantity of placer gold.

*Randolph County.*—In Randolph County there was no production in 1908 from the Boson, Empire, Redding, or Southern Homestake mines. The latter property, though but slightly developed, was equipped with a 100-ton milling and cyaniding plant only to prove disappointing by reason of low-grade ores and insufficient development of large bodies of them. A shut down followed the failure of ores to pay for an expensive and apparently too hastily erected mill. The Scarlett copper mine has been practically closed since the fall in price of copper in 1907.

*Rowan County.*—In Rowan County the Gold Coin mine, of the Southern Mining Company, at Gold Hill, produced a small output of gold from the operation for two weeks of the 10-stamp concentrating mill. The main shaft is 180 feet deep, and about 700 feet of underground work was reported for 1908. The Park mine was shut down, and the well-known Union mines were closed. The Gold Hill mines were worked but a short time, pending reorganization of the company operating them, but produced some gold, silver, and copper.

*Rutherford and Stanly Counties.*—There was a small placer production in Rutherford County, and the Double Branch mine yielded a small output of gold from ore obtained in development work. In Stanly County, also, there was but a small placer production in 1908.

*Swain County.*—There was no output reported from the Everett mine of the North Carolina Copper Mining Company in Swain County during the year.

*Union and Other Counties.*—In Union County production was confined to

\*Hafer, Claud, Notes on Mining in North Carolina: Min. World, vol. 28, 1903, pp. 332-333.

\*\*Lyon, E. W., The Progress of Gold Mining in North Carolina: Eng. and Min. Jour., vol. 87, 1909, pp. 295-296.



a small output of gold from prospecting the Davis mine, near Matthews, operated by the Winona Mining Company. The Phifer mine, on the Price tract of the holdings of this company, and the Black, Brewer, Indian Trail, and Union Mining and Milling Company mines, were all idle in 1908. There was also no production reported from any of the mines or prospects in Warren, Watauga, Wilkes, and Yadkin counties during the year.

Mr. McCaskey, in his report for 1909\*, reviews the production of gold and silver by counties, as follows:

*Burke County.*—In Burke County there was, as usual, a small placer production from several properties. The Mills hydraulic mine was again the most important producer.

*Cabarrus County.*—Six producers reported an output of gold in Cabarrus County in 1909, the largest production coming from the dumps of the old Miami (or Phoenix) mine, near Concord.

*Catawba County.*—In Catawba County the Catawba Gold Mining Company, operating the England and Shuford mines, produced gold and small quantities of silver in 1909.

*Cleveland County.*—There was a small placer output of gold from operations near Shelby, in Cleveland County, in 1909.

*Franklin County.*—The Portis mine, near Louisburg, produced a small quantity of surface gold in 1909.

*Gaston County.*—A nominal production of gold was reported from Gaston County for 1909.

*McDowell County.*—In McDowell County there was a nominal output of placer gold in 1909.

*Mecklenburg County.*—In Mecklenburg County the Southern and Surface Hill mines yielded small quantities of gold in 1909. The St. Catherine-Rudisil and many other mines of this county were idle.

*Montgomery County.*—In Montgomery County the Iola mine yielded a greatly decreased output of gold in 1909. \* \* \* The company operating the Iola mine has been recently reorganized, and the plant is reported to have been remodeled and enlarged.

*Nash County.*—There was a nominal output of gold in 1909 from the Mann-Arrington mine in Nash County.

*Randolph County.*—In Randolph County the Ashboro mine yielded a nominal production of gold in 1909.

*Rowan County.*—There was a small output of surface gold from Rowan County in 1909, and a production of gold, silver, and copper, from ores mined at Gold Hill. The Southern mine is equipped with a 10-stamp mill and is developed by a 175-foot shaft. The Union Copper Mines Company shipped copper-gold ore and concentrates to smelters on the Atlantic seaboard in 1909.

The ore deposits of the important Gold Hill district have recently been studied and described in detail by Laney.†

*Rutherford County.*—There was a nominal production of placer gold from Rutherford County mines in 1909.

*Stanly County.*—In Stanly County a small output of placer gold was reported from Whitney in 1909.

*Union County.*—The Bonnie Doon mine, in Union County, near Indian Trail, made no production in 1909, but development work was done and experiments were made in the treatment of low-grade ores. The shaft is 200 feet deep, and the plant includes a slow-speed, 25-ton, Chilean amalgamation and concentration mill.

*Yadkin County.*—Development work was reported from the Gross and Dixon mines near Cana, in Yadkin County, in 1909, and plans were formed for the erection of a smelter.

\*Advance chapter from Mineral Resources of the United States for the year 1909 on Gold, Silver, Copper, Lead, and Zinc in the Eastern States, pp. 12-14.

†Laney, F. B., The Gold Hill mining district of North Carolina: Bull. North Carolina Geol. and Econ. Survey No. 21, Raleigh, 1910.

A review of the gold and silver industry in North Carolina during 1910, by counties, is given below:

*Burke County.*—Practically all of the gold and silver from Burke County was obtained from placer deposits near Bridgewater and Brindletown, among the deposits worked being the old Mills Hydraulic mine where some attempt was made to mine on a large scale. Sluicing was only partially successful at this mine, even with expensive equipment, including a Canton Hughes pump and 2,400 feet of 8" and 6" pipe through which water was raised 650 feet. The surface material covered hard rock to a slight depth and hydraulic mining failed. Attempts were made to develop the Hedge and White bank mines with some success.

*Cabarrus County.*—The principal output from Cabarrus County was obtained from re-working the dumps of the old Phoenix or Miami mine.

*Catawba County.*—The Catawba or Shuford mine was worked in open cuts for a short while during 1910 by steam shovel, conveyors, and washers, and yielded considerable gold. The England mine also made a small output of gold.

*Caldwell County.*—There was no production of gold from this county during 1910, but the owners of Carey's Flatt mine in Caldwell County state that there is a prospect of working this mine during 1911. Mr. J. A. Dula, of Lenoir, writes that he has a mine five miles south of Lenoir, claiming 400 acres of rich placer. He expects to organize a company to work same.

*Franklin County.*—The Portis mine of Franklin County reported a small production which was the outcome of a demonstration plant for testing the values of the property. The plant showed 65 per cent per cubic yard of values in runs of 100 yards or more. Development work is about completed. A 2,000-yard aerial cable wire plant is expected to be put in operation during 1911, and later a gold dredge of 5,000 yards capacity.

*Gaston County.*—A small production of gold was reported from Gaston County during 1910, principally from the Kings Mountain and Burrell-Wells mines. The former yields a small production annually, largely from re-working the old dump, and the latter was worked only during the first part of the year, later being closed and its machinery sold.

*Jackson County.*—A slight production of gold and silver was reported from Jackson County, this being obtained in connection with a small amount of copper mining at the Cullowhee mine. The Cullowhee Mining and Reduction Company are the owners of this mine and expect to equip a large plant.



*McDowell County.*—A small output of placer gold was reported from McDowell County during 1910.

*Mecklenburg County.*—The principal output of gold from this county during 1910 was obtained by the Catawba River dredge near Charlotte. The Piedmont Placer Mining Company, of Mecklenburg County, report that they had some tests made on their gravel in 1910, which were very promising. They have a steam dredge, shovel, sluice boat, and machinery for pumping. The Surface Hill Mining and Milling Company report that they have recently purchased the Surface Hill mine and have begun preliminary work.

*Montgomery County.*—A considerable production of gold was made from the Iola mine near Candor, which has been the principal gold producing mine of the State for many years. Their mill and cyanide plant was completely destroyed by fire, however, during the latter part of 1910, and a letter from the owner in February, 1911, stated that they had just started the construction of a new plant. Their old plant consisted of a Lehigh-Fuller mill and cyanide equipment with Parroll agitating tanks and an Oliver vacuum filter. A production was also reported from the old Coggins and the Golconda mines. The old Coggins mine, after standing full of water for 28 years, was unwatered during 1910. The shaft was re-timbered and some cross-cutting and drifting were done during the latter part of the year. The plant includes a 10-foot, 40-ton Chilean mill with crusher, Pierce amalgamators and concentrators and they propose to deepen the mine from the 200 foot shaft.

*Moore County.*—The Elise mine of Moore County made no production during 1910, but hope to produce during 1911.

*Nash County.*—There was some slight activity at the Mann-Arrington mine during 1910, and some other prospects near Nashville were reported to show gold and copper ores of some promise. These new finds are all on farm land not far from the Portis mine and are known as the Braswell, Nelms, Williams, Strickland, and Griffin prospects.

*Orange County.*—The North State or Robertson mine did very little work during 1910. There is expected to be a reorganization of the controlling interests.

*Person County.*—The entire output of gold and silver obtained from Person County during 1910 came from the Durgy mine, which supplied siliceous copper ore to the Ducktown (Tennessee) smelters during 1910. The Duke mine was prospected in 1910.

*Polk County.*—The Double Branch Gold Mining Company actively developed their mine during 1910. They have a 10-stamp mill, and one

3-stamp mill, a 40 h. p. engine, with boilers, and a Blake crusher. They have sunk two shafts on Big Vein, 35 and 50 feet respectively, to the 200 foot level. Work was also being done on two other veins.

*Randolph County.*—Prospecting on the Scarlett mine near Asheboro yielded a small amount of gold and the Talbert property also produced on a small scale. The Southern Homestake mine did some development, showing two new parallel pay streaks 5 feet wide, composed of schistose ore, yielding \$12 and \$4.50 gold and silver values respectively. The company has a 100-ton cyanide plant with a Blake crusher, etc. Mr. George Crawford, of New York City, has leased the John Laughlin gold mine, located about two miles west of the Sawyer mine. He expects to install a mill and concentrate the sulphide ores. The ore deposit is a quartz porphyry and slaty quartzite, with some of the locally known "Indigo ore." Mr. E. W. Lyon, of Greensboro, states that there are two parallel ore deposits about 150 feet apart and that when he examined it in 1908 it was opened by three prospect shafts, of 15, 25, and 34 feet depth respectively, showing  $3\frac{1}{2}$  to 7 feet in width. The average assay values were from \$3.48 to \$14.20 per ton, the ore carrying 2 to 3 per cent of sulphide of iron.

*Rowan County.*—The mines at Gold Hill, in Rowan County, made but a small output in 1910. Preparations are being made to unwater the 850-foot Randolph shaft of the Gold Hill property. At the Union Copper mine the No. 12 shaft, which develops the gold vein, with traces of copper, was sunk 100 feet to the 400-foot level. A gold vein was opened up on the 230-foot level and mill tests were made on the ore. From No. 7 shaft, which develops a copper vein, with traces of gold, a sample shipment of ore was made. Mr. John Q. Foreman, of Salisbury, who now owns the Drexler mine in Providence Township, reported that in 1910 he was blowing out the old mine preparatory to mining. He has a 30 h. p. boiler, with  $1\frac{1}{4}$ -inch pump. The Steele placer near Cleveland was a producer in 1910.

*Rutherford County.*—Mr. John F. Jones, of Blacksburg, S. C., states that he expects to do considerable development work during 1911 on his mine in Rutherford County.

*Union County.*—The Bonnie Doon mine near Indian Trail made a considerable output in 1910. This property is opened by a 170-foot shaft and ore was stoped in 1910 from both 120- and 170-foot levels. A considerable quantity of old dump material has also lately been sent through the mills. The plant includes a 10-foot, slow-speed, Lane mill, built in 1910, and provision is made both for amalgamation and concentration. The Winona Mining Company, of Matthews, Union County,



made no production during 1910, but state that they have a Huntington 5-foot mill with engine and boiler and a Ledgewood hoisting engine with boilers and pumps and expect to begin mining during 1911.

*Wilkes County.*—The Flint Knob mine of Wilkes County expects to continue development work during 1911.

*Yadkin County.*—The Gross and Dixon Gold Mining Company, of Nebraska, have a mine located near Cana, in Yadkin County, N. C. The property consists of 66 acres of mineral land. They have sunk three shafts. Shaft No. 1 is 100 feet deep, with about 400 feet of drifting; shaft No. 2 is 50 feet deep, and shaft No. 3 is 30 feet deep. They have erected a 5-stamp mill, including a tube mill, and complete cyanide plant of 50-ton capacity, assay and refining equipment, etc. Their method of treatment is by stamp mill, re-grinding by tube mill, and then by cyanidation.

#### PRODUCTION.

In the following table there is given the production of gold and silver, by counties, in 1907, 1908, 1909, and 1910, which will illustrate the distribution throughout the State.\*

PRODUCTION OF GOLD AND SILVER IN 1907 AND 1908 BY COUNTIES.\*\*

County	1907			1908		
	Gold	Silver	Total	Gold	Silver	Total
Burke.....	\$ 2,976	\$ 13	\$ 2,989	\$ 3,479	\$ 15	\$ 3,494
Buncombe.....				96		96
Cabarrus.....	1,521	1	1,522	12,231	44	12,275
Catawba.....	6,274	45	6,319	2,053	17	2,070
Cleveland.....				1,558	6	1,564
Davidson.....	386	109	495			
Franklin.....	1,186	2	1,188	108		108
Gaston.....	300		300	841	2	843
Granville.....	145	2,226	2,371			
Guilford.....	1,863		1,863	64	1	65
McDowell.....	222	1	223	348	1	349
Mecklenburg.....	7,744		7,744	1,146	45	1,191
Montgomery.....	52,438	410	52,848	59,603	425	60,028
Moore.....	225	1	226			
Orange.....				295		295
Person.....	145	2,226	2,371	4,500	55	4,555
Polk.....				776	2	778
Randolph.....	300		300	83	4	87
Rowan.....	3,683	9,243	12,926	5,707	40	5,747
Rutherford.....	223	1	224	1,405	4	1,409
Stanly.....	50		50	1,053	5	1,058
Union.....	500	21	521	2,149	2	2,151
Unknown.....	2,014		2,014			
Total.....	\$ 82,195	\$ 14,299	\$ 96,494	\$ 97,495	\$ 668	\$ 98,163

\*The gold and silver statistics have been obtained for 1907 principally through the Director of the Mint at Washington, D. C. The figures given for 1903, 1909 and 1910 have been estimates based upon figures obtained partly through the U. S. Assay office at Charlotte, N. C., and the collection of statistics by the State Survey. The counties given in these tables do not represent all the producing counties, but the production has been given, as far as possible, of the principal producing counties and the balance is given as "unknown."

\*\*Coining value.

## PRODUCTION OF GOLD AND SILVER IN 1909 AND 1910 BY COUNTIES.\*

County	1909			1910		
	Gold	Silver	Total	Gold	Silver	Total
Burke.....	\$ 4,535	\$ 19	\$ 4,554	\$ 1,059	\$ 4	\$ 1,063
Cabarrus.....	1,838	8	1,846	228	1	229
Catawba.....	12,000	63	12,030	363	3	366
Cleveland.....	844	6	850			
Davie.....	1,496	14	1,510			
Franklin.....	29	10	39	1,039	2	1,041
Gaston.....	520	13	533	281	1	282
Granville.....	2,000	4	2,004			
Jackson.....	340	37	377	508	165	673
Lincoln.....	1,482	11	1,493			
McDowell.....	340	10	350	34		34
Mecklenburg.....	803	10	818	906	2	908
Montgomery.....	1,475	11	1,486	53,628	239	53,867
Moore.....				48		48
Nash.....	81		81			
Person.....				300	4,410	4,710
Randolph.....	1,476	11	1,487	3,856	17	3,873
Rowan.....	10,727	57	10,784	2,940	8	2,948
Rutherford.....	345	12	357			
Stanly.....	1,000	13	1,013	32		32
Union.....				3,364	36	3,400
Yadkin.....	800	12	812			
Unknown.....	939	6	945			
Total.....	\$ 43,075	\$ 324	\$ 43,399	\$ 68,586	\$ 4,888	\$ 73,474

\*Coining value.

As will be seen from the above tables, Montgomery County led in the production of gold and silver during 1908 with a production of \$60,028; Rowan led in 1909 with a production of \$10,784; and Montgomery regained her lead in 1910 with a production of \$53,867.

The next table gives the value of the gold and silver produced in North Carolina from 1882 to 1910, inclusive.

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA  
FROM 1882 TO 1910.\*

Year	Gold	Silver	Total
1882.....	\$ 190,000	\$ 25,000	\$ 215,000
1883.....	167,000	3,000	170,000
1884.....	157,000	3,500	160,500
1885.....	152,000	3,000	155,000
1886.....	175,000	3,000	178,000
1887.....	225,000	5,000	230,000
1888.....	136,000	3,500	139,500
1889.....	145,000	3,878	148,878
1890.....	118,500	7,757	126,257
1891.....	95,000	6,465	101,465
1892.....	78,560	12,671	91,231
1893.....	53,600	17,325	70,925
1894.....	46,594	455	47,049
1895.....	54,200	520	54,720
1896.....	44,350	646	44,946
1897.....	34,600	388	34,988
1898.....	84,000	905	84,905
1899.....	34,500	388	34,888
1900.....	44,653	15,986	60,639
1901.....	60,410	34,023	94,433
1902.....	93,650	30,212	123,862
1903.....	113,604	16,907	130,511
1904.....	123,924	19,133	143,057
1905.....	129,153	20,216	149,369
1906.....	122,003	30,944	152,932
1907.....	82,195	14,299	96,494
1908.....	97,495	668	98,163
1909.....	43,075	324	43,399
1910.....	68,586	4,888	73,474

\*Coining value.



**COPPER.\***

Two reports have recently been issued by the North Carolina Geological and Economic Survey relating to the copper deposits of the State, one as Bulletin No. 21 on the Gold Hill mining district, by Dr. F. B. Laney, and Bulletin No. 22, a report on the Cid mining district of Davidson County, by Dr. Joseph E. Pogue, Jr. There is now in preparation a report, to be published in coöperation with the Virginia Geological Survey, on the Virgilina Copper District, which will practically complete a series of reports covering the copper deposits of the State. Owing to the low price of copper most of the copper mines have made small or no productions during the past few years. There is given below a brief description of the Virgilina District, prepared by Dr. F. B. Laney, who has made the field investigations on the whole Virgilina District of both North Carolina and Virginia for the North Carolina Geological and Economic Survey under the supervision of the two State Geologists.

**THE COPPER ORES OF THE VIRGINIA DISTRICT OF NORTH CAROLINA AND VIRGINIA.†**

BY FRANCIS B. LANEY.

**INTRODUCTION.**

The copper ores of the Virgilina district consist almost wholly of bornite and chalcocite. The level of ground water is from 50 to 75 feet below the surface and the zone of secondary alterations does not appear to extend below 250 feet. The important mines of the district are from 350 to 500 feet deep and the ore from the deepest levels contains almost as much chalcocite as bornite. If a specimen from the upper levels of almost any of the mines be examined in detail it is found to consist of the two minerals in such relations that no hesitancy is felt in pronouncing the chalcocite secondary and younger than the bornite. If, however, the specimen be taken from the deeper levels the two minerals are seen to be so intricately intergrown that no other conclusion than that they are genetically contemporaneous seems possible. These facts led some observers, notably L. C. Graton‡, to suppose that chalcocite occurs in these mines as a primary mineral. Chalcocite has been almost universally regarded as a mineral of secondary origin, *i. e.*, derived from some leaner copper-bearing sulphide. Its manner of occurrence as heretofore

\*See also Bulls. 21 and 22, and Economic Papers, No. 6, pp. 20-25, and No. 15, pp. 20-55.

†Economic Geology, Vol. VI, No. 4, pp. 399-411.

‡U. S. Geol. Survey, Min. Res. 1907, Pt. I, p. 620.

observed left little doubt as to its secondary nature and there grew up a belief that the mineral is always secondary. The chalcocite of the Virgilina district therefore appeared to offer an exception to this generally accepted conclusion, and, with the hope of throwing some light upon the genesis of this mineral, a detailed microscopical examination of these ores was undertaken.

The field work upon which this investigation is based was done while the writer was employed by the Geological Surveys of North Carolina and Virginia and a detailed report on the geology of the district is now being prepared. This report will be published as a coöperative report by the North Carolina Geological and Economic Survey and the Virginia Geological Survey. This is probably the first time that a report covering a geological area embraced by two states has been published on such a coöperative basis by the two states.

#### GEOGRAPHY AND GEOLOGY.

Before entering upon a description of the ores a brief sketch of the geology of the district will be given.

*Location.*—The Virgilina copper district is located near the eastern border of the Piedmont Plateau in Person and Granville counties, North Carolina, and Halifax and Charlotte counties, Virginia, each State including approximately one-half of the ore-bearing area. It takes its name from the village of Virgilina, a station on the Southern Railway situated on the State line near the center of the district, and about 160 miles west of Norfolk and 45 miles east of Danville. The most important ore deposits occur on two approximately parallel flat-topped, though somewhat conspicuous, ridges which trend from 15 to 20° east of north, and which have very gradual slopes. The maximum elevation is at Virgilina, 540 feet above sea level. The relief is not pronounced, varying from about 300 feet up to the maximum above stated, but the country is decidedly hilly. Rainfall is rather heavy, especially during the winter and spring, and streams are numerous.

*Geology.*—The rocks of the district are highly schistose, and are popularly known as slates. They are of two distinct types, greenstone schists, and quartzose sericitic schists or gneisses. Into these schistose rocks have been intruded large areas of granite, and less important masses of more basic material, probably gabbro. Also here and there throughout the area occur small diabase dikes. The intrusive rocks are not schistose, and, were it not for the numerous joints which cut them, they would be perfectly massive.



A close examination of these schists readily reveals their true character—a great series of volcano-sedimentary rocks of two types: a decidedly basic rock, andesite; and one highly acid in character, a quartz porphyry. Of the andesite there are three types: porphyritic, amygdaloidal, and tuffaceous; and of the quartz porphyry only two—porphyritic and tuffaceous. Closely associated with the greenstone schists and grading directly into them are heavy beds of highly schistose greenish rocks differing from the tuffaceous portions of the andesite only in that they contain varying amounts of land waste intermixed with the basic volcanic material. These range from fairly well-marked sandstone and fine conglomerate on the one hand, to typical andesitic tuffs entirely free from terrigenous material on the other. The relative position of these two phases of the greenstone indicates that at the beginning of the volcanic activity there was a period when the volcanic material was not equal to the land waste, and thus were deposited beds of sandstone and conglomerate with only a small amount of ash from the volcanoes. As the activity increased, the amount of land material grew proportionately less and less, until at the time of maximum vulcanism it became nil, and the normal volcanic beds were formed. As this activity began to diminish the former conditions commenced to reassert themselves, and the beds deposited consisted to a greater or less extent of land waste.

The andesite and andesitic tuff pass by regular gradation into the sandy and conglomerate rock, so that in the field where exposures are the best it is not possible to draw a sharp boundary line between the two.

It is possible that the sandy beds may have been formed from the rapid erosion of unconsolidated volcanic ash beds as well as by the commingling of similar material with land waste at the time of eruption. Thus in either case it is clear that with an increase of the volcanic material the resulting rock would more nearly approach the true basic tuffs, while with a decrease of this it would approximate more nearly a normal sediment—a conglomerate, sandstone, or shale as the case might be.

The andesite and the andesitic tuff, especially the former, are the most massive of the older rocks of the region. The andesite is of two types, porphyritic, and amygdaloidal, both being much mashed and decidedly schistose. The amygdaloidal phase is not abundant, and is usually so highly metamorphosed that it is easily confused with the tuffaceous phase. All the ore deposits thus far developed, and in fact all the prospects as far as known at present, with a very few exceptions, are located in the andesite or the andesitic tuff.

The quartz porphyry is, for the most part, especially on the western

side of the area, a typical rock of its kind, but much mashed and highly schistose. The phenocrysts are largely of feldspar, with a variable and usually an inferior amount of quartz. The basal and the upper, and at times other portions of this rock, are to a greater or less extent tuffaceous. This is especially true of the eastern area, where by far the greater portion is probably a very fine tuff. No workable ore deposits have been found in this rock.

The age of these rocks is unknown; they have generally been regarded as pre-Cambrian. They appear to be somewhat similar to tuffaceous rocks intimately associated with the slate deposits lying northeast of the Virgilina district. These slates have recently been described by Watson\* and Powell and shown to be early Paleozoic. It is believed that further study may determine the volcano-sedimentary rocks of this district to be of the same age.

*The granite.*—This is the youngest intrusive rock of the district except the diabase dikes, and is also the most important. Three prominent areas of it are included within the district, one in the southwest corner near Mill Creek postoffice, North Carolina, and another in the east-central portion at and surrounding Buffalo Lithia Springs, and the third and largest one, northwest of Red Oak postoffice, Virginia. This area of granite extends almost across the region of volcano-sedimentary rocks and cuts out the ore-bearing horizon for a distance of four or five miles. It is apparently massive, and therefore shows nothing of the prominent schistosity of the other rocks. In all the occurrences it is a rather coarsely granular, highly quartzose rock, and at times, especially at Buffalo Lithia Springs, it is decidedly porphyritic. Like all the other granites of the southeastern United States it contains a large amount of plagioclase in proportion to the orthoclase, and shows well its quartz-monzonitic character. This rock is of especial interest in that all the field evidence obtainable points toward the conclusion that it is the source of the ores, and that they and the veins are closely connected genetically with its intrusion. In this relation it is further considered in the paragraphs relative to the origin of the ores.

#### THE VEINS AND ORES.

*The veins.*—The veins are of quartz with locally a considerable amount of epidote and calcite. In width they vary from small stringers not more than a few inches up to 15 or 20 feet. They always have well-defined walls, and are probably true fissure veins. As is always the case with such veins, these present many irregularities, most prominent of

\*Fossil evidence of the age of the Virgilina Piedmont slates, Thos. L. Watson and S. L. Powell, Amer. Jour. Sci., Ser. IV, Vol. 31 (1911), pp. 33-44.



which are the numerous pinches and swells, both linearly and vertically. At times they are reduced to little more than a mere stringer of quartz between two well-marked walls, while again they may locally swell out to more than twice their average thickness. In length they range from a few hundred yards to four or even five miles, and in many instances may be traced these distances by actual outcrop or by abundant quartz debris in the soil. Vertically they are also continuous, and aside from the irregularities in width, they are as well-defined in the bottom of the deepest shafts as at the surface. The size of the vein and the prominence of the outcrop form no criteria as to the richness of the mineralization. Often the richest ore bodies have been found under a very insignificant outcrop, and as often the strongest exposure at the surface is barren or very lean. The average strike of the veins is more northerly than the schistosity of rocks in which they occur, and while at times they follow the schistosity for short distances, their average strike intersects it at acute angles. The fractures in which the veins have formed are, therefore, regarded as having been made subsequent to the development of the schistosity in the country rock. The ore is not evenly distributed throughout the veins, but is concentrated locally into definite ore shoots. These present the usual irregularities and as a rule appear to have a slight southerly pitch in the vein.

*The ores.*—Though apparently preferring the quartz, the ore is so intimately associated with all the gangue material as to make it almost certain that all were deposited contemporaneously. The copper-bearing minerals are bornite and chalcocite with the oxidized products derived from them. Chalcopyrite is present in such small and varying amounts that unless careful search is made it will not be found at all, and it is apparently no more abundant in one portion of a mine than in another. Certainly there is no increase with depth in the amount of this mineral. In fact the mine which shows it most abundantly is only about 150 feet deep, and here it was as abundant in the first sulphides encountered as in those in the bottom of the shaft. In two of the deepest mines, the Holloway, 450 feet in depth, and the Durgy, about 400 feet, it is so rare that one can hardly find it.

Chalcocite occurs in two very distinct relations with the bornite, secondary to and filling fractures in the bornite, and intergrown, sometimes clearly crystallographically, with it. Bornite is the most important mineral in all the mines in the district except the Holloway, in which it is subordinate to chalcocite. It appears, too, from even a casual observation of the ores that there has been considerable shattering since their original deposition. This is especially prominent in the

ore from the Seaboard mine which furnishes the purest bornite in the district. In the fractures in the bornite from this mine, be they ever so minute, are developed veinlets of chalcocite, which penetrate the bornite in all directions, and vary in size from the finest line, often not visible to the unaided eye, but perfectly clear under the microscope, up to areas a quarter of an inch in diameter. In the center of many of these chalcocite-filled fractures are films of quartz which evidently mark the original fracture in which the chalcocite began to develop, thus showing that at the beginning of, or prior to the development of the chalcocite, there were solutions carrying considerable quartz. In the interior of some of the largest quartz veinlets thus formed there occur particles of chalcocite so related to each other as to indicate a growth of the quartz since the beginning of the deposition of the secondary chalcocite. Also in a few instances the vein of chalcocite when deeply etched, presents a kind of spongy skeleton of quartz appearing as if quartz and chalcocite were deposited simultaneously. The boundary between these veinlets of chalcocite and the bornite is exceedingly irregular, usually presenting a somewhat feathery outline, though always perfectly distinct and clear-cut. There is absolutely no gradation of one into the other. There is certainly a growth of the chalcocite, but how it takes place is not made clear by the microscopic study of the veinlets. It appears, however, that it takes place at the periphery of the already-deposited material, but the chemistry of the process has not been worked out. Where fractures of two periods are present they are both often filled with chalcocite, that in the younger fractures cutting across the veinlets in the older ones. Fractures also occur in the intergrown chalcocite and bornite, and in such instances the secondary veinlets cut across both the primary chalcocite and the bornite. The relation of the two minerals to each other in the case in hand leaves no doubt as to the secondary nature of the chalcocite. This type of chalcocite, as far as observations have extended, is confined to the upper portions of the veins and was not found in sections of ore from the deeper mines. It was found, however, in the upper portions of all mines from which sections were examined, and in many instances a single section would show excellent examples of both types of chalcocite.

The other type of ore is entirely different. Both minerals are present in every section examined, sometimes the bornite predominating, and at others the chalcocite. They are intimately associated with each other, but each has its own definite boundaries, cleavage, and other physical properties, with absolutely no indications that one is secondary to or derived from the other. In a number of sections the chalcocite predom-



inated over the bornite, and in such instances the indications seemed to be that the bornite was the first to crystallize. It occurs in irregular areas, sometimes separated and again connected, lying in a larger area of chalcocite. In other instances the two are present in approximately equal amounts, and there is nothing to indicate that one is older than the other. In other occurrences, as in the ore from the Blue Wing mine, the two minerals are present as small areas or grains and in approximately equal proportions. In these sections the appearance is as if a sponge of bornite while growing had been merged with another similar sponge of chalcocite, the association being so intimate and so complex that there is no way of accounting for it except on the basis of contemporaneous deposition. In the case of the sections in which the bornite appears to have been formed earlier than the chalcocite, it seems as though when the ores were being deposited the solutions were first saturated, as it were, for bornite, and this mineral began to crystallize out, the iron possibly being the determining factor. This continued until by a reduction of the bornite molecules in the solution the eutectic point for both bornite and chalcocite was reached, and these two minerals crystallized out simultaneously, and at times were intergrown crystallographically. The chalcocite is rather coarsely crystalline, and the etch figures show that the larger areas are made up of numerous interlocking grains, which stand out distinctly and have no definite crystallographic relation to each other. The cleavage, as brought out by the etching, is apparently in two directions at right angles to each other, one more prominent than the other, one possibly prismatic and the other basal.

The crystallographic intergrowths are the most interesting and also the most conclusive as to the contemporaneous deposition of the two minerals. These are by no means rare, having been found more or less perfectly developed in ore from all the mines except the Seaboard. At a magnification of 40 diameters these areas resemble very closely the intergrowths of quartz and feldspar in a micropegmatite. At the highest magnification used, 220 diameters, this resemblance is even more pronounced. In these intergrowths the minerals present perfectly sharp and clear-cut boundaries, with absolutely no indication of gradation of one into the other—boundaries just as sharp as between any minerals in an igneous rock. When an area of such intergrowth was etched deeply enough to bring out the two cleavages distinctly the chalcocite proved to be a single grain or crystal, the cleavage lines of which could be seen extending from one side of the grain to the other, interrupted here and there by the filaments of bornite. This type of texture among

minerals is possible only when they crystallize at the eutectic point of a solution, and it is, therefore, conclusive proof that in the case in hand bornite and chalcocite were deposited contemporaneously.

It is realized that while these minerals are contemporaneous, they both may be secondary after some leaner copper mineral. There are certain reasons for suspecting such conditions, the most prominent of which is probably the long period of erosion which the region had undergone since the ore deposits were formed. This long erosional interval would afford time for conditions of oxidation and enrichment to penetrate to exceptional depths in the ore bodies. With this idea in mind careful observations were made as to the depth of the zone of alteration as far as the same could be determined, and the conclusion is that it rarely if ever extends below 175 or 200 feet. The reason for its not extending to greater depths is the fact that the veins are so tight. They and their walls are all exceedingly dense and impervious to water, and the mines all furnish a surprisingly small amount of water, of which by far the greater part comes from the upper 100 feet of the vein. As an example of the tightness of the vein it may be mentioned that when the Blue Wing mine was unwatered about two years ago, it was found that the air pressure had held the water out of an upraise which had been started from the 266-foot level. The vein rocks were so tight that the air could not escape even though it was under a pressure of about eight atmospheres. Under such conditions as these, circulation of meteoric waters must necessarily be at a minimum. This tightness of the vein is characteristic of practically all the ore deposits of the Piedmont and Southern Appalachian regions.

The relations of ore to the gangue, and of the gangue minerals to each other are strong evidence against the assumption that the two sulphides are secondary minerals. It has been stated before that the ore is so complexly and intricately associated with the gangue minerals that no other conclusion than that of contemporaneous deposition seems tenable.

The minerals of the deposits, both gangue and ores, as a group, with the possible exception of the chalcocite, if they can be said to be characteristic of any one portion of a mineral vein, would probably be typical of the deeper vein zone.\* These are, so far as has been determined, quartz, calcite, epidote, chlorite, specularite, bornite, chalcocite, a very little chalcopyrite, albite, probably orthoclase, and a lime-bearing plagioclase. It must be stated that feldspar of any kind in direct associa-

\*Lindgren, Waldemar—Relation of ore deposition to physical conditions, *Economic Geology*, Vol. 2 (1907), pp. 105-107.

Emmons, W. H.—A genetic classification of minerals, *Economic Geology*, Vol. 3 (1903), pp. 611-627.



tion with the sulphides is rare, but good examples were found at the Seaboard mine, where the feldspar is a plagioclase, probably albite; at the Holloway mine where both plagioclase and a pink feldspar which is apparently orthoclase, occur, and at the Copper King mine where the feldspar is a lime-bearing plagioclase. Feldspars, however, are very abundant in many of the veins, especially in lean or barren portions. In such occurrences the mineral is generally albite or an acid oligoclase. In certain portions of the veins at the gold mine near Red Bank, Virginia, and Holloway mine in North Carolina, pink feldspar occurs in association with quartz so as to strikingly resemble a pegmatite. This is generally not closely associated with the ore, but at times, especially in the Holloway mine, it carries a small amount of the sulphides. It usually is found in barren portions of the vein or as stringers running off from the vein into the country rock.

*Origin of the ores.*—The origin of these ores is a more difficult question than one might at first suspect, and is as important as difficult. The country rock is by far too basic to have afforded the vast amount of quartz in the veins. Neither can the underlying quartz porphyry be looked to as the source, since this rock is also older than the veins and is itself cut by numerous quartz veins similar in all respects to those in the andesite and andesitic tuff except that they contain but little or no calcite and epidote and probably no copper ores. Some source, therefore, outside of and much younger than the country rocks must be looked for. The only rock in the region which apparently meets the conditions is the granite. This granite is highly quartzose, younger than the rocks in which the ore deposits occur, not intruded until after a strong schistosity had been imposed upon the andesitic rocks, and is a type of magma the intrusion of which is nearly always attended by more or less mineralization in the intruded or adjacent rocks. It is also well able to furnish the acidic material of the veins, and in its effects upon the intruded rocks through hydrothermal metamorphism, could very well have been responsible for the development of the calcite, epidote, and probably the chlorite. In fact it appears to be the only rock in the region that could have furnished the feldspars of the veins, or have been responsible for the pegmatite-like character of certain portions of some of the veins. It is, therefore, believed that the dynamic metamorphism attendant upon the intrusion of the granite, produced the fractures in which the veins now are, and that the filling of these, both gangue and ores, was supplied by the granitic magma, and that it came in as a phenomenon attendant upon or immediately following the intrusion.

As to the conditions of the deposition, there is little or no very positive evidence. Since the ore deposits are confined to the more basic facies of the schists, it may be surmised that the basic character of the rock was a factor of prime importance in the deposition of the ores.

#### SUMMARY AND CONCLUSIONS.

The rocks of the Virgilina district are greenstone and sericitic schists which in places have been intruded by granite and gabbro. The intrusive rocks show none of the schistosity of the other rocks. The schists have been derived from a series of volcano-sedimentary rocks of two types—andesite and quartz porphyry, with a preponderating amount of tuffs corresponding to these rock types. Their age is probably early Paleozoic.

The veins are dyke fissure veins, which have a more northerly trend than the schistosity of the country rock, and the filling of which is quartz—about 70% silica—with local and varying amounts of epidote and calcite. The ore-bearing veins are confined to the more basic portions of the greenstone schists, and the values lie in well-defined ore shoots.

The ores are bornite and chalcocite. They apparently prefer the quartz, but are not confined to any one of the gangue minerals. Bornite is present in slight excess over chalcocite and is apparently of only one period of deposition. Chalcocite is clearly of two periods: one confined to the upper portions of the vein, younger than and filling a network of minute fractures in the bornite; the other contemporaneous and intergrown often crystallographically with it. There is no evidence that any of the bornite is of secondary origin. It is, therefore, clear that in the Virgilina district the greater part of the chalcocite is a primary mineral contemporaneous with the bornite and in no way derived from it, or any other copper mineral, by processes of secondary alteration.

#### PRODUCTION.

During 1908, 1909, and 1910 the Blue Wing and Copper King mines of the Virgilina district, in Granville County, were idle.

*Jackson County.*—During 1908 there was reported some development work done at the Cullowhee Copper mine in Jackson County and a 30-ton smelter and 10-ton lixiviation plant were reported in course of erection. A production was made from this mine in 1909 and also 1910. The mine is developed by a vertical shaft 177 feet deep and by a 4,000-foot tunnel, and is equipped with a plant including a 40-ton water-jacketed Allis-Chalmers copper furnace. In 1910 the company reported that they expected to equip a larger plant still for handling their ores.



*Person County.*—The Durgy mine of Person County reported a small production of copper ore during 1910, but not sold on account of the low price of copper. During the year 1910 they opened a 400-foot level from the 500-foot level and started stopes between the third and fourth levels.

*Rowan County.*—A small production was made by the Union Copper mine of Gold Hill, and during 1910 they sunk 100 feet of shaft and made about 100 feet of lateral development. The Salisbury Copper Company, of Rowan County, reported that nothing was done in 1910, but there were prospects of further development in 1911. The Gold Hill Consolidated Company, of Rowan County, made a small production during 1910 and state that the outlook for future development is good.

In the table below there is given the production of copper ore, amount of copper obtained from this, and its value for the years 1900 to 1910, inclusive.

PRODUCTION OF COPPER FROM 1900 TO 1910, INCLUSIVE.

Year	Crude Ore Mined	Copper Produced	Value
	<i>Tons</i>	<i>Pounds</i>	
1900.....	6, 948	512, 666	\$ 41, 600
1901.....	10, 398	1, 417, 020	76, 900
1902.....	16, 741	458, 133	212, 553
1903.....	4, 106	305, 060	67, 037
1904.....	4, 250	488, 888	36, 600
1905.....	10, 000	703, 775	88, 000
1906.....	11, 729	597, 878	135, 829
1907.....	11, 011	180	116, 416
1908.....	180	19, 393	2, 560
1909.....	3, 575	224, 512	29, 186
1910.....	2, 221	140, 514	17, 845

As will be seen from the above table there has been a pretty steady decrease in the production of copper since the year 1907, due to the low price of copper ore.

### IRON.\*

North Carolina contains enormous deposits of iron ore, but they represent future sources of supply. There are but few of the iron ore deposits in the State which are capable of being developed and operated at the present time owing to the low price of pig iron and the distance of the ores from the furnaces and from sources of supply of fuel and flux.

The Cranberry mine of Mitchell County, however, contains two bodies of magnetite from which is produced a pig iron of exceptional quality which commands a higher price than ordinary pig iron.

\*See also Bull. 1 of the N. C. Geol. Survey.

Recently there was much discussion as to the control of the iron ores of the United States by corporations, and the State Geologist was called upon by the *Manufacturers' Record* to make an estimate of the iron ores in North Carolina not controlled by such interests. Below is given an estimate of what is termed "present supply." By this is meant a supply under prices that existed eight years ago when it was possible to work some of the ores which cannot now be worked on account of the low price of iron.

Magnetite .....	6,650,000 tons.
Titanic magnetite .....	1,510,000 "
Hematite .....	250,000 "
Limonite .....	725,000 "

Below is given an estimate of what may be termed "future supply" of iron ores, by which is meant ores that can be worked when the price of pig iron and other conditions are such as to warrant it. In this estimate an arbitrary depth of 100 feet has been taken, but nothing below this.

Magnetite .....	8,975,000 tons.
Titanic magnetite .....	1,300,000 "
Hematite .....	900,000 "
Limonite .....	5,000,000 "

#### PRODUCTION.

In the table below there is given the production of iron in North Carolina from 1900 to 1910, inclusive.

PRODUCTION OF IRON ORE IN NORTH  
CAROLINA, 1900-1910 INCLUSIVE.

Year	Amount Long Tons	Value
1900. ....	21,000	\$ 42,000
1901. ....	2,578	4,997
1902. ....	34,336	52,771
1903. ....	82,851	78,540
1904. ....	64,347	79,846
1905. ....	56,282	70,352
1906. ....	56,037	75,638
1907. ....	75,638	113,488
1908. ....	48,522	76,877
1909. ....	61,150	107,013
1910. ....	65,278	114,237

#### TIN.\*

During the past three years there has been no production of tin from the deposits of this metal in North Carolina, although there has been a certain amount of development work carried on at the deposits owned by the Piedmont Tin Company near Lincolnton, Lincoln County.

\*See also Bull. 19 of the N. C. Geol. Survey.



### ABRASIVE MATERIALS.\*

During the past three years the production of abrasives has been confined entirely to a small production of garnet and millstones. The corundum deposits have not been worked at all. Practically all the corundum now used in the United States is imported, and comes mainly from Canada, in pulverized form, and the emery from Greece and Turkey.

Garnet is being mined by Mr. N. N. Rogers at Shooting Creek, Clay County, who has large quantities of this material.

#### PRODUCTION.

In the table below there is given the production of abrasive materials in North Carolina, including garnet and millstones, from 1901 to 1910, inclusive.

PRODUCTION OF ABRASIVE MATERIALS, 1901-1910 INCLUSIVE.

Year	Corundum		Garnet		Millstones		Total Value
	Quantity	Value	Quantity	Value	Quantity	Value	
	<i>Tons</i>		<i>Tons</i>		<i>Pairs</i>		
1901.....	325	\$ 48,840	775	\$ 43,600			\$ 91,840
1902.....			260	10,040	50	1,425	11,465
1903.....			**403	12,250	63	902	13,152
1904.....			**202	6,586	208	6,500	13,086
1905.....	†1,150	9,000			196	2,652	11,652
1906.....					205	4,100	4,100
1907.....							†15,469
1908.....						4,052	4,052
1909†.....						9,188	9,188
1910†.....						7,981	7,981

### MICA.‡‡

Among the many varieties of mica only two are considered of economic importance because of their physical properties; *i. e.*, muscovite and phlogopite. Of these two varieties muscovite alone is found in quantities of commercial importance in North Carolina. Small quantities of biotite mica (black mica) have been used for commercial purposes within the last few years, however, and another variety, the lepidolite, has been used as a source of lithium salts. Chemically, muscovite is a silicate of aluminum and potash with a small amount of water; phlogopite is a silicate of magnesium, aluminum and potassium; and biotite is a silicate of magnesium, iron, aluminum, and potassium. The three micas are very similar in physical properties except color. In

\*See also Bull. 11, and Vol. I, of the N. C. Geol. Survey.

\*\*Including production of corundum.

†Including production of garnet.

‡Including corundum, garnet and millstones.

‡‡See also Economic Papers, No. 6, pp. 40-47; No. 9, pp. 26-35; No. 14, pp. 82-103.

thin sheets muscovite is nearly colorless and is frequently called "white" mica; phlogopite is generally yellow or brownish and is called "amber" mica; biotite is dark brown to black, approaching black even in thin sheets. Each of these varieties of mica has strongly developed cleavage, so that it may be split into very thin, highly flexible, and elastic sheets. These properties of flexibility and elasticity, together with its toughness, transparency, and non-conductivity of heat and electricity, render mica, and especially muscovite, which possesses these qualities in a high degree, particularly useful for industrial purposes. The sheets can be trimmed and bent into a variety of forms according to the use required of them.

Below is given a report\* on the Mica Deposits of North Carolina, written by Mr. Douglas B. Sterrett, of the United States Geological Survey. This supplements a similar report made by Mr. Sterrett and published in Economic Paper No. 14 of the North Carolina Geological and Economic Survey.

### MICA DEPOSITS OF NORTH CAROLINA.

BY DOUGLAS B. STERRETT.

Mica is used in various industries, such as the manufacture of electrical machinery, stoves, certain forms of lamp chimneys, fireproof materials, wall papers, lubricants, etc. The perfect insulating qualities of mica and the adaptability of its sheets to various forms of manufacture render it unsurpassed for use in electrical apparatus. By fitting together and cementing with shellac many small thin sheets, mica is built up into large sheets of "micanite" or "mica board," suitable for many forms of electrical insulation. The transparency, flexibility, and resistance to heat of mica are qualities that make it particularly suitable for use in stove windows and lamp chimneys. When ground, mica is used to impart a silvery luster to wall paper and for other decorative effects. Ground mica is also mixed with oils and grease for lubricating purposes. When mixed with shellac, ground mica is used in various types of electrical insulators under the term "molded mica."

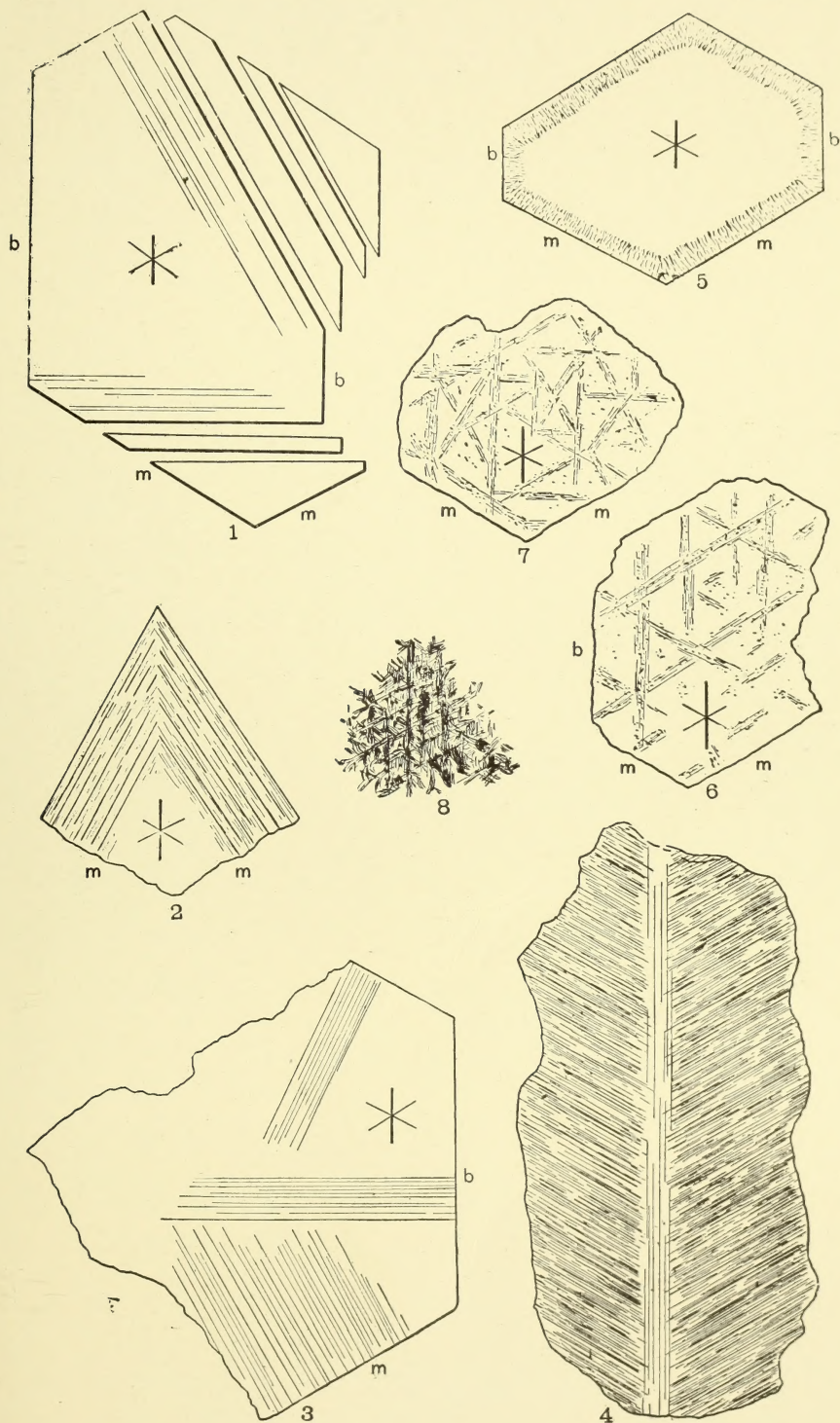
The information for the present paper has been obtained at various times during the last five years in the course of work for both the United States Geological Survey and the North Carolina Geological Survey. The greater part of the mine descriptions were obtained during 1905, 1906, and 1907 and represents typical deposits in all those counties in which mica mines have been examined by the writer. A large number of other descriptions have been prepared also, which it is hoped will be used in a later report by the State Survey. The brief notes on the general geology of the region and on the mica deposits are largely taken from an earlier paper,† in which the occurrence of mica-bearing pegmatites and their origin were treated, rather than commercial mines.

A number of the mica deposits of North Carolina were opened in prehistoric times by aborigines. Some of these operations have been described in the early days of mica mining by white people, and several of the deposits where such work was done, are described below. The present period of mica mining was begun in 1867 by L. E. Persons, of Philadelphia, previously of Vermont. Mr. Person's attention was directed to Jackson County by some-

\*U. S. Geological Survey, Bulletin 430-J, advance chapter from Contributions to Economic Geology, 1909.

†Mica deposits of western North Carolina: Bull. U. S. Geol. Survey No. 315, 1907, pp. 400-422.





SPECIMENS OF MICA OF VARIOUS STRUCTURE.





one in Philadelphia who had seen a crystal of mica exhibited at the State Fair in Columbia in 1858 by D. D. Davies, of Webster. In the fall of 1867 Mr. Persons went to Jackson County and learned from Mr. Davies the location of favorable prospects for mica in Jackson and Haywood counties, which he soon opened.\* Shortly after this the mica industry began in Yancey and Mitchell counties with the opening of the Silvers mine by Thomas L. Clingman.

#### CHARACTERISTICS OF MICA.

Of the numerous varieties of mica there are but four that have commercial value. These are muscovite, phlogopite, biotite, and lepidolite. Muscovite and phlogopite have a wide application in both sheet and ground form. Biotite has only recently been used in the ground form. Lepidolite is used as a source of lithia salts and to a small extent for ornamental purposes. Muscovite is the only mica that has been mined extensively in North Carolina, and it is only within two years that a small demand has arisen for biotite for grinding.

Muscovite, like all the micas, belongs to the monoclinic system of crystallization and has a symmetry approximating the hexagonal. This symmetry is indicated by the nearly hexagonal outlines often observed in the prisms, by the percussion and pressure figures, and by "ruled" and "A" mica, as described below.

Mica mined for commercial purposes is generally found in rough blocks, sometimes with an irregular development of crystal faces. The faces are not usually as many as would be required to complete the simplest figure, and their surfaces are generally very rough. Very commonly a large part, if not all, of a block of mica has a ragged outline without plane surfaces. Occasionally fairly well developed hexagonal or rhombic prisms are observed in crystals of mica weighing hundreds of pounds.

Rough crystals, or "books" of mica, as they are called in the Western States, do not split perfectly until the outer shell of etched and sometimes partly crushed mica has been removed. This is accomplished by rough splitting or cleaving the large book into sheets one-eighth inch thick or less and trimming the edges with a knife held at a small angle with the cleavage. Further splitting is then easy, because the cleavage of mica is so perfect and the tangled outside edges of the sheets have been removed. By grinding a wedge edge on the sheets and using a thin sharp knife mica can be readily split into sheets as thin as one-thousandth of an inch or thinner.

A percussion figure is formed by three cracks or cleavages in a plate of mica crossing at a common point and making angles of approximately  $60^\circ$  with one another, commonly described as a six-rayed star. It may be produced by striking a sheet of mica a sharp blow with a pointed punch or thrusting the punch through the sheet. The same thing is produced occasionally on a large scale in a mine by a miner unintentionally striking the cleavage face of a block of mica with a pick. One of the rays, sometimes noticeably more prominent than the other two, corresponds in direction with the front axis of a mica crystal. The other two rays are parallel to the prism faces, *m*. (See Pl. I, *a* to *g*.)

A pressure figure is very similar in appearance to the percussion figure, but oriented with its rays at angles of about  $30^\circ$  with those of the percussion figure. The pressure figure is seldom obtained with the same symmetrical, perfect development as the percussion figure and is often very difficult to obtain. By pressing with a punch against a sheet of mica one or more rays of the pressure figure may be produced, and if the punch is then thrust through the sheet a percussion figure will also be formed and the two may be seen with their approximate  $30^\circ$  relation to each other.

Mica has a number of physical peculiarities which give rise to different trade names and descriptive terms used by the miners. These are due to crystal structure, color, and inclusions. Structural peculiarities give "ruled"

\*This information was furnished by Judge D. D. Davies and Mrs. John L. Richardson, daughter of L. E. Persons, in a certified statement dated March 22, 1907.



or "ribbon," "wedge," "A," "hair-lined," "fishbone" or "herringbone," and "tangle-sheet" mica. Trade names for different colors of mica are "rum," "ruby," "amber," "white," and "black." Brown, green, and greenish-brown colors also occur in mica. Certain inclusions give "specked" and "clay-stained" mica.

"Ruled" or "ribbon" mica is formed by more or less clean, sharp parting planes cutting through the mica crystals and making an angle of a little more than  $66^\circ$  with the base or cleavage surface. This parting passes entirely through some crystals and in others extends only part way across the face or does not cut through the entire thickness. (See Pl. I, *a*.) The trace of the ruling planes corresponds in direction to the rays of the pressure figure in mica. Though a cleavage resembling ruling may be produced by making a series of percussion figures along the line of one of the rays, it is evident that "ruling" planes do not correspond to the lines of weakness represented by the percussion figure, for the two make angles of about  $30^\circ$  with each other. On the other hand, the ruling planes fall in the same direction as the rays of the pressure figure and probably occur along the lines of weakness represented by them.

"Ruling" lines occur more commonly in one series of parallel lines in mica. In some specimens these parting planes are present in two or even three directions, and their traces on the cleavage planes make angles of about  $60^\circ$  with one another, dividing the mica sheets up into small triangular plates. The value of large blocks or crystals of mica, otherwise of excellent quality, is sometimes rendered small or practically nothing by the presence of many "ruled" lines.

In "wedge" mica the crystals are thicker on one side than on the other. The difference in thickness on opposite edges may be greater than half an inch, in some crystals 3 inches in diameter. This structure is due to an unequal development in the width of the laminae. Some of the laminae extend across the entire width of the crystal, but others do not, and generally they are not matched by similar laminae extending from the opposite edge. In this way a greater thickness is developed on one side of a mica crystal than on the other. It is not uncommon for wedge-shaped sheets of quartz to be included between the laminae of such crystals. The "wedge" structure is often associated with the "A" and "fishbone" structure.

In "A" mica there are two series of lines or striations crossing the sheets at angles of about  $60^\circ$  with each other, whence the term "A." (See Pl. I, *b* and *c*.) In some pieces these striations are caused by "wedge" structure developed in the mica crystals, with or without the presence of detached swordblade-like strips of mica replacing the sheets that have "wedged" out. In other specimens the striations are caused by small folds or crenulations in the sheets of mica. The "A" striations have the same orientation in the mica sheets as the "ruling" lines; that is, their position corresponds to the rays of the percussion figure. "Ruling" is sometimes present in "A" mica. Where the striations are caused by small folds the mica sometimes splits across them and the sheets have a commercial value, though not as high as perfect plates. Where the striations are due to the "wedging" out of sheets, only plates from between the "A" lines can be used commercially and the value of large crystals is thus materially affected.

In the "fishbone" or "herringbone" structure striations with or without "ruling" and apparently identical with the "A" lines of mica make angles of about  $120^\circ$  with each other and join along a center line or spine. This gives a structure resembling the skeleton of a fish, as shown in Plate I, *d*. The "fishbone" structure is probably caused by a twinning of two crystals of "A" mica, so that one set of striations in each fall together and the other two sets are inclined toward each other and meet at the twinning line. Mica with the 'fishbone' structure has no commercial value as sheet mica, but is used for scrap for grinding.

In "tangle-sheet" mica (a name little used) the laminae split well over a portion of their extent but tear when split in other parts. This is due, in some places, to the failure of certain laminae to form perfect sheets and the intergrowth of portions of one sheet with that lying next to it. Such im-



perfections sometimes extend through half an inch or more of the thickness of a crystal of mica. In this way an apparently sound crystal of mica is rendered of little value or worthless for sheet purposes.

The color words descriptive of mica are self-explanatory, except the "white" and "black" mica of commerce. In speaking of the color of mica the miners or dealers ordinarily consider the color of sheets a sixteenth of an inch or more in thickness. Such colors as "rum," "ruby," "green," etc., observed in the thicker sheets of mica, practically disappear when the mica is split into thin sheets for trade purposes. The mica is then called "white" mica to distinguish it from phlogopite or "amber" mica. By "black" mica is generally meant muscovite "specked" with magnetite, as described below, but in some cases dark-brown to black biotite is also called "black" mica. "Rum," "ruby," "green," and the lighter-colored micas make the best grades of "white" mica for the glazing trade. Dark brown and brownish-green mica has to be split much thinner than "rum" mica to gain the desired transparency and is therefore generally classed as "No. 2," even when flawless and clear.

Some muscovite shows color variations arranged in accordance with the crystal structure. These more commonly appear in zony bands following the crystal outline. Thus, to one looking through the sheets there may appear a center of dark "rum" color with a fringe of light "rum" or yellow surrounding it and possessing a hexagonal or rhombic outline; or the center may be light colored and the border zone dark, as in Plate I, *e*. In some sheets there are alterations of bands of varying color. Such color variations generally entirely disappear when the mica is split into sheets of the thickness required by the trade.

The pleochroism of mica is strong and may be well observed in small crystals with prism planes sufficiently smooth to transmit light. It will be found that crystals of such mica viewed edgewise are far more transparent than sheets of the same thickness. The color is also quite different in these two views.

Muscovite containing inclusions between the laminae of spots of particles of different-colored minerals is called "specked" and sometimes also "black" mica. Magnetite is the most common inclusion between the laminae and occurs as black to brown dendritic tufts arranged in definite lines or patterns corresponding to the crystal structure of the mica or scattered irregularly through the sheets. These tufts of magnetite are very thin and rarely penetrate appreciable thicknesses of mica. The dark-brownish color of many of these spots is due to the translucency of the thin films of magnetic iron. The arrangement of the streaks of spots in the mica is in some cases parallel to the direction of the rays of the percussion figure (Pl. I, *f*) and in others apparently parallel to the rays of the pressure figure (Pl. I, *g*). Each spot owes its dendritic appearance to the arrangement of still smaller particles of magnetite in lines following in some cases at least, the rays of the percussion figure. (See Pl. I, *h*.) From these lines of particles other particles branch off at more or less definite angles. By decomposition the magnetite is sometimes partly or entirely altered to hematite or limonite and the "specks" become red or yellowish brown. In this way striking patterns in colors are produced, which gives rise to the name "hieroglyphic" mica and which were once thought to be the inscriptions of the aborigines.

In the zone of surface weathering, and principally within a few feet of the surface, mica crystals are sometimes "clay-stained." This is due to the working in of clayey solutions between the laminae. The solutions penetrate large areas of some crystals and work in between many of the laminae, greatly damaging the value of the mica.

"Specked" or "clay-stained" mica has little if any value in the glazing trade, though either can be used in electrical manufacture. Their application even in the latter industry is less extensive than that of clear or "white" mica. Mica with "specks" of magnetic iron is not satisfactory for insulation where electric currents of high potentiality are used, because the "specks" tend to weaken the insulating qualities by acting as lines of less resistance.

Occasionally crystals or sheets of biotite are included in the muscovite



crystals, or vice versa. In such a case the two micas generally occur in parallel intergrowths and have a common cleavage plane. Large crystals of muscovite sometimes inclose smaller ones with no definite orientation. The cleavage of the included crystal is generally inclined or at right angles to that of the host.

#### DISTRIBUTION OF DEPOSITS.

Mica deposits have been opened in 18 or more counties in Western North Carolina. The deposits occur in an area nearly 75 miles wide and 200 miles long, extending in a northeast and southwest direction through the State. (See fig. 1.) For convenience this area may be divided into three belts—the Cowee-Black Mountain belt, the Blue Ridge belt, and the Piedmont belt. The Cowee-Black Mountain belt extends nearly through the State, parallel

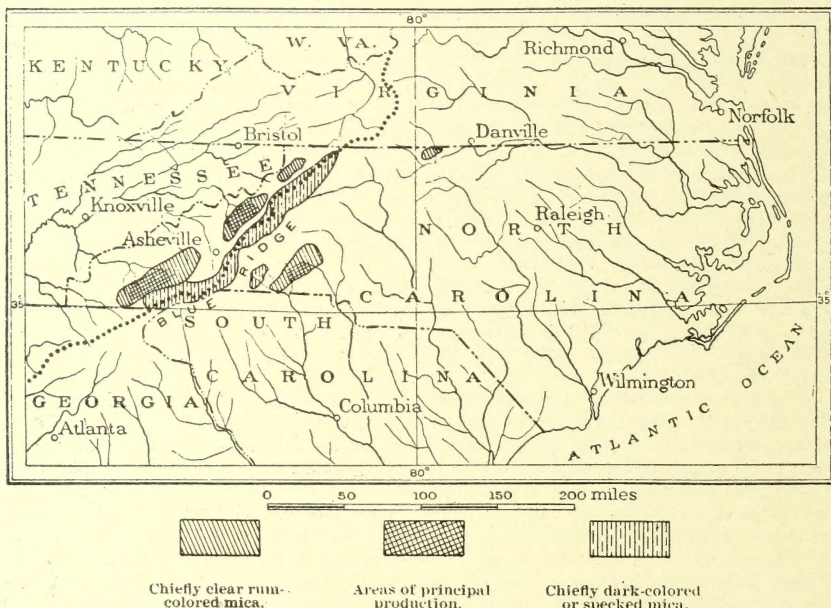


FIGURE 1.—Map showing areas in North Carolina in which mica has been mined.

to and near its northwest border. It lies northwest of the Blue Ridge and includes part of Macon, Jackson, Transylvania, Haywood, Buncombe, Yancey, Mitchell, Watauga, and Ashe counties. The Blue Ridge belt follows the Blue Ridge through the State and extends several miles to the southeast among the foothills. It is of small importance compared to the other two. Mines have been opened in Jackson, Transylvania, McDowell, Caldwell, and Wilkes counties in this belt. The Piedmont belt lies in the Piedmont Plateau and its small mountains, southeast of the Blue Ridge. Mica mines have been worked in Rutherford, Burke, Cleveland, Gaston, Lincoln, Catawba, and Stokes counties of this belt. Mica deposits of commercial value have not been found in unbroken succession in any of these belts.

The quality of mica obtained from different localities varies considerably, though in a single belt or in adjacent portions of the same belt the quality is commonly very similar. In general the mica of the Cowee-Black Mountain belt is clear and of a light color (as a rule "rum"). That from the Blue Ridge belt has a dark smoky-brown or greenish-brown color and much of it is more or less "specked." In a large part of the Piedmont belt, especially in Cleveland, Gaston, and Lincoln counties, the mica is of good quality and similar to that of the Cowee-Black Mountain belt. There are exceptions



to these characteristics, in part connected with geologic conditions, such as the presence or absence of granite near by. Most of the mines described below are in the Cowee-Black Mountain belt. Exceptions are the Rochester mine in Jackson County, the Reed mine in Transylvania County, and the Triplett mine in Wilkes County, all in the Blue Ridge belt, and all the mines in Rutherford, Cleveland, Lincoln, and Stokes counties, in the Piedmont belt.

The Cowee-Black Mountain and the Blue Ridge mica belts are in the heart of the Appalachian Mountains. The deposits lie at various elevations between 1,500 feet above sea level and that of the highest mountains, or more than 6,500 feet. Some are high upon rugged slopes or summits where the soil covering is thin. Others are on the gentle slopes of valleys, or former plateau levels or terraces, covered by deep residual clays. Many of the deposits present ideal conditions for mine drainage. This is an important point, for the rainfall is excessive and the level of ground water is not deep. The deposits in the Piedmont belt occur in the low but locally steep ridges or in the few higher hills or mountains standing above the general level of the plateau. The plateau lies from 800 to 1,500 feet above the sea in the mica region and is more or less dissected by river and creek valleys 200 to 300 feet deep. The sky line seen from any prominent ridge is approximately level, with mountains or peaks rising above it at intervals. The problem of mining mica from deposits in the Piedmont belt is often difficult on account of their occurrence in hills with but slight elevation and gentle slopes so that natural drainage can not be readily secured.

#### GENERAL GEOLOGY.

The mica deposits of North Carolina have been found in highly metamorphic rocks, probably all of Archean age. These rocks are mica, garnet, cyanite, staurolite, hornblende, and granite gneisses and schists. Other rocks occurring in the region, also of Archean age, are granites, diorites, and peridotites, with their derived soapstones and serpentines. Younger granites, volcanic rocks, diabase, and sediments occur in parts of the region. The folding, faulting, mashing, and re-crystallization of the gneisses and schists have been so extreme that it is often difficult to determine the original igneous or sedimentary nature of the formations.

The major part of the mica deposits occur in two formations, as mapped by Keith\*—the Carolina gneisses and the Roan Gneiss. The Carolina gneiss includes most of the gneisses and schists mentioned above that are not hornblendić in composition. The Roan gneiss is composed of hornblende, gneiss and hornblende schist with smaller beds of mica gneiss and mica schist included. In the mica region by far the most important formation is the Carolina gneiss. This formation is also the oldest in the region and is intruded by younger igneous rocks, as hornblende gneiss and schist, peridotite, granite, granite gneiss, and diabase. Beginning with the Carolina gneiss the formations have been gashed and cut by the later igneous rocks into irregular-shaped masses, in many places forking out into long tongues or occurring as long, narrow streaks in the intrusives, or vice versa. The diabase rocks are probably of Triassic age and cut across the strike of the older formations in long, narrow dikes. The Carolina and Roan gneisses have been interbanded with and cut at all angles by numerous streaks of granitic or pegmatitic material. These range from a fraction of an inch upward in thickness and locally pass into mica-bearing pegmatites. In some places this pegmatization is so thorough that mica gneisses become strikingly like granite gneisses.

#### OCCURRENCE OF MICA.

Mica deposits of commercial value in this State are confined to pegmatites. These rocks vary considerably in form, some being typically lenticular in shape and others more or less persistent in length. The lens-shaped

\*Cranberry (No. 90), Asheville (No. 116), Mount Mitchell (No. 124), Nantahala (No. 143), Pisgah (No. 147), and Roan Mountain (No. 151) folios, Geol. Atlas U. S., U. S. Geol. Survey.



bodies are generally conformable with the schistosity of the enclosing rock. They may lie in the same line of bedding or schistosity and be connected by smaller streaks or stringers of pegmatites, or by mere seams in the rock. Many of them, on the other hand, lie in planes of schistosity more or less separated from one another and form parallel or overlapping bodies. In cross section some of these lenses are short and bulky, with a length only two or three times the thickness; others are long and tapering and may constitute simply a bulge in a sheet of pegmatite. In many places the schistosity of the inclosing rock bends around the lenses.

Some of the more persistent pegmatites occupy straight fissures that hold their direction for a considerable distance. Elsewhere they are folded with the country rock or bent and twisted into various shapes. Many are more or less conformable with the bedding of the gneisses and schists. In that case they are in large measure subject to the deformations of the country rock. In many places, however, the pegmatites are conformable for some distance and then branch out, cutting from one layer to another across the bedding. Locally there is an elbowing or bulging out on one wall, without a similar irregularity on the other wall of the pegmatite. It is not uncommon for pegmatite masses to cut across the country rock for long distances.

Though pegmatites have been worked for mica in regions of hornblende gneiss and hornblende schist, where they are directly associated with those rocks, most of the deposits are found in small biotite gneiss or schist masses included in the hornblende areas. Where the pegmatite is in contact with hornblende gneiss, the latter may be highly biotitic.

Pegmatites occur in irregular masses, streaks, lenses, augen, or balls, some of them having no visible connection with other pegmatite bodies. They range from a fraction of an inch up to many yards in thickness. The limit of size below which they can not be profitably worked for mica might be placed arbitrarily at 1 to 2 feet for rich and regular "veins." In the very large pegmatites the mica is not, in general, evenly distributed through the mass, but is richer in one portion than another, so that the entire bulk of the rock does not have to be removed in mining. The irregularities of pegmatites and the consequent difficulties in mining mica from them are well illustrated in road cuts or similar excavations, where pegmatized gneiss or schist has been exposed. The lenticular shapes, pinching and swelling, crumpling, folding, and faulting to be observed in these cuts are found to be nearly duplicated in larger pegmatites opened for mica. As stated before, these smaller masses may grade into those containing mica of commercial value. Here and there the two can be seen at the same locality.

Horses, or inclusions of wall rock, are common in pegmatite. Some of them are in the form of bands or sheets parallel to the walls, and the schistosity of these bands is also parallel to the walls. They range from an inch or two up to several feet in thickness, and their length may be many times their width. Elsewhere they occur as irregularly shaped masses, from a few inches up to several feet thick. If the bedding has been preserved, it may lie at any angle with that of the inclosing wall rock. In some places the horses are partly pegmatized by streaks of pegmatite ramifying through them and by the development of considerable feldspar and quartz through their mass. In such places no sharp line can be drawn between the pegmatite and the original horse.

Pegmatite is closely allied to granite in composition. As in granite, the essential constituents are feldspar and quartz, with more or less mica and other accessory minerals. Though hornblende is rather a common mineral in granite, it is less so in pegmatite. Orthoclase and microcline are the most common varieties of feldspar found in pegmatite. In many places, however, a variety of plagioclase, either albite or oligoclase, makes up part or all of the feldspar component. The feldspar occurs in masses and rough crystals, some of them with a diameter of several feet.

Quartz assumes various forms and positions in the pegmatite. In many places it bears much the same relation to the feldspar and mica as in granite, the three minerals being thoroughly mixed with one another; but the



individual grains are many times larger than in ordinary granite. Not uncommonly the quartz and feldspar assume a graphic granite texture in a portion of the pegmatite. Another common feature is the occurrence of large separate masses of quartz occupying various positions in the pegmatite. Such quartz masses may be irregular in form and but little influenced by the shape of the pegmatite or inclosing wall. Many of them, however, lie in bands or sheets parallel to the walls. There may be one or more of these quartz bands constituting varying proportions of the pegmatite. Their thickness ranges from a fraction of an inch up to 6 or more feet. Many of them are lenticular in shape, the length varying from four or five to twenty or more times the thickness. In numerous places these quartz streaks or veins are persistent through the whole length of the pegmatite exposed. Some inclose feldspar or mica bodies; others do not. The quartz of these segregations is massive and generally granular, though locally crystallized. If crystallized it may be translucent or clear and of a dark, smoky or light color. It is generally rather pure and does not contain feldspar or mica in appreciable quantity.

Muscovite is the common mica of pegmatite and is the only variety mined in North Carolina. Biotite occurs in moderate quantity in a few deposits, and in smaller amounts in many others. Where muscovite and biotite occur together in a deposit, the muscovite is generally clear and of good color. Again, mica from deposits in rock formations where the ferromagnesian minerals are abundant, such as hornblendes or biotite gneiss and schist, is generally found to be clear and of light color. Where the pegmatite is closely associated with or occurs in granite with a paucity of the ferromagnesian minerals, the mica is generally of dark color and much of it is "speckled."

The mica occupies various positions in the pegmatite. Where the rock has a typical granitic texture the mica may be found evenly distributed through it. More commonly the larger crystals will be found either in clusters at intervals through the "vein" in places connected by streaks of small crystals, or collected along one or both walls of the pegmatite, with some of the crystals partly embedded in the wall rock. Where there is a quartz streak within the pegmatite, the mica occurs on either or both sides of it. The mica may be partly embedded in the quartz or be scattered through the remaining portion of the pegmatite, which generally is composed largely of feldspar.

"Mica capping" is a miner's term for an aggregation of mica and quartz, with or without feldspar and other minerals, in which the mica is small or occurs in distorted crystals so as to be of small commercial value. The idea conveyed, that the mica forms a capping to a regular "vein" below or near by, is not necessarily true, for some such deposits carry nothing but "mica capping." The mica of "mica capping" commonly occurs in "wedge" shaped blocks with the "A" structure, in many places is more or less distorted or twisted, and may contain inclusions of quartz.

Aggregations consisting wholly or almost wholly of mica crystals occur in some of the pegmatites. Some of these masses measure several feet across. The crystals composing such massive mica range from a small fraction of an inch to 2 inches or more in diameter and thickness. Massive mica generally occurs in irregular shaped bodies without definite arrangement in the pegmatite.

A large number of minerals have been found associated with mica in pegmatite. Some of these have commercial value in manufacturing industries, or as gems and specimens. The feldspar associated with the mica deposits of North Carolina has not yet been used commercially, but the kaolin formed by its decomposition has been mined extensively. Some of the kaolin deposits are worked for that mineral alone, as they contain little if any merchantable mica. Numerous deposits that may prove of value for both mica and kaolin are known.



## DESCRIPTION OF MINES.

## MACON COUNTY.

*Smith or Baird Mine.*—The C. D. Smith mine is about a mile west of Franklin. It was worked on a large scale by aborigines, as described below. The mine was opened in the early days by C. D. Smith, and last in 1905 and 1906 by Mr. Eldridge, of Franklin. None of the operators were successful in finding large bodies of mica after the work of C. D. Smith. Some of the later workings cut through layers of scrap mica in old dumps and openings filled with rubbish. Some of this scrap mica was of sufficiently good quality for electrical uses. Several shafts were sunk near the old openings on the top of the ridge but failed to locate the "vein." One of the later tunnels from stream level encountered the filling material of ancient workings and could not be driven farther on account of the loose ground caving badly. About 75 yards northwest of the shafts, across a small branch, a small amount of work was done along a quartz ledge striking N. 60° W. The country rock at this mine is mica gneiss, containing more or less biotite and garnet, with a few diorite inclusions. The mica has a clear "rum" color and is of good quality. Considerable biotite is associated with the muscovite. A large sheet of mica measuring 16 by 18 inches is still kept in the Baird house near the mine as a specimen of the material obtained during the operations of C. D. Smith. The early operations at this mine have been well described by Mr. Smith, and his description is quoted below.\*

"The ancient works on my own farm are the most extensive I have yet seen and are therefore worthy of description. The vein, as I have proved by my drifting upon it, has a general strike of N. 73° W., S. 73° E. So far, however, as I have drifted upon it, it runs in a zigzag along this general strike. The old excavation commenced at a small branch and runs at a right angle from it into a ridge that juts down with a gentle slope. The dump material has been thrown right and left for the first hundred feet. I tunneled in diagonally and struck the vein 60 feet from the branch, and have drifted along it 40 feet. Here we reach an immense dump rim, 65 feet higher than the level of the branch, and which seems to have been thrown back upon their works. It forms at this end a circular rim to the continued excavations higher up the ridge. The whole length of the excavation from the branch to the upper end of the cut is about 320 feet. The material removed from the upper part of the cut was carried up the hill as well as down it. The dump on the upper side of this upper part of the cut, and at the widest point, is about 25 feet above the bottom of the excavation, and at this point dump and excavation measure about 150 feet across. At the upper end of my tunnel the old digging has been carried down about 30 feet below the surface. If the excavation at the point just mentioned was carried as deep as the work of the upper end of the tunnel, it would make the dump heap on the upper side 55 feet higher than the bottom of the old works. I have been thus particular, in order to show that with mere stone implements it must have required a series of years and a large force to have accomplished such results."

*Iotla Bridge Kaolin and Mica Mine.*—The Iotla Bridge mine, 4 miles N. 10° W. of Franklin, has been worked for both kaolin and mica. The last work was by the Franklin Kaolin and Mica Company in 1907. The deposit lies in the hill along the west bank of Little Tennessee River, near the mouth of Iotla Creek. The developments consist of eight or ten tunnels, about the same number of shafts and pits, and two good-sized open cuts. The deepest shaft is 65 feet deep and was sunk from the summit of the hill, 120 feet higher than the lowest opening. Two other shafts were sunk to depths of 40 and 45 feet and connected with underground works. The workings extend over a distance of 550 feet, starting in a northwesterly direction at the south end, swinging to north and south along the hilltop, and ending with a northeasterly trend at the north end. The kaolin formation and country rock have the same sweeping curved trend. The country rock is mica gneiss with associated hornblende gneiss streaks.

\*Smith, C. D., Ancient mica mine in North Carolina: Rept. Smithsonian Inst., 1876, pp. 441-443.



The pegmatite is irregularly conformable with the inclosing gneiss and may not be one body over the whole length of the developments. The thickness of the pegmatite body varies from a few feet to nearly 100 feet. In places the feldspar component was massive and has thoroughly decomposed, giving large masses of pure kaolin. In other places there is considerable mica and quartz mixed through the feldspar, and these still remain in the kaolin. Large bodies of sugar quartz were encountered in the workings and a large mass outcrops on the hilltop west of the shafts. Boulders of quartz are scattered over the hillside below part of the pegmatite outcrop and in the river along the west bank at the north end of the deposit. The greater part of the mica yield from this mine has been in small sizes. During 1907, however, one large crystal that weighed over 4,000 pounds was found in a small tunnel connecting with the 65-foot shaft. This crystal was somewhat irregular in shape, though possessing a rough rhombic outline. It measured about 29 by 36 inches and was about 4 feet thick. It was not sufficiently solid to yield sheets of this size, though much material 12 to 18 inches square was obtained. The block was sold in the rough for \$1,500. The quality of the mica from this mine is excellent and the color a rich "rum."

**Chalk Hill Mine.**—The Chalk Hill mine is  $1\frac{1}{2}$  miles east of Burningtown. Operations have extended over a distance of 200 yards up the west side of a ridge to the top and for 150 yards down the east side. The principal workings with the deepest shafts are on the west side of the ridge considerably below the top. The country rock is interbedded hornblende and mica gneiss, with a strike of N.  $80^{\circ}$  E. and dip of  $75^{\circ}$  N. The main lead of the mica deposits is parallel with the schistosity of the country rock, though small streaks of pegmatite were observed cutting the strike of the gneiss. Outcrops of massive sugary quartz occur along the whole line of openings, and large bodies of it were cut in some of the workings. Two or more "veins" have been developed by the main lead of workings. Thirty yards south of the point where the main lead crossed the ridge another pegmatite streak carrying mica was exposed in a cut. The mica from this mine is clear and has a beautiful "rum" color. A little biotite is associated with it, and in some places the two are intergrown.

**Burningtown or Poll Miller Mine.**—The Burningtown mine, 3 miles S.

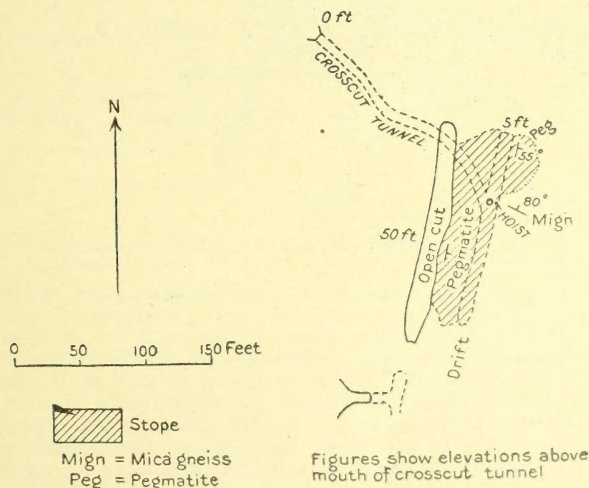


FIGURE 2.—Plan of Burningtown or Poll Miller mine, Macon County, N. C.

55° E. of Burningtown Bald, was opened before 1880. It was worked intermittently until 1903, and from then until early in 1906 on a larger scale by

the Flint Mica Company, of Flint, Mich. This company equipped the mine with electric-power drills, hoisting machinery, and lights. The power drills were discarded during the last year of operations and hand drills only employed. Electricity was generated by a dynamo and turbine using the fall of a neighboring stream. The workings consist of a large open cut, a crosscut tunnel with drifts and stopes, and a small prospect tunnel with short drifts on the level of the open cut. The drifts from the main crosscut tunnel are about 45 feet lower than the open cut. The "vein" has been removed above the drift by a large stope extending to the bottom of the open cut. An incline stope was also driven from the drift to a depth of 45 feet. A plan of the workings is shown in figure 2. A hoist was located in the drift at the end of the crosscut tunnel.

The country rock is mica gneiss with a strike of N. 70° W. to east and west and a dip of 80° N. The pegmatite cuts across the country rock with a strike of N. 10° E. and a dip of 55° E. It varies from 6 to 12 feet in thickness and carries quartz streaks. One of these has a maximum thickness of 4 feet and is near the middle of the pegmatite. The mica yield is from the feldspar streaks between the quartz and mica gneiss walls. The quality of the mica from the Burningtown mine is excellent and the color a clear "rum." The production is said to have been large while the mine was in operation.

*Hall and Welch Mines.*—The Hall and Welch mines are on opposite sides of the same ridge, 5 miles N. 60° W. of Franklin, and may well be described together. The relative position of the two mines with a plan of the work-

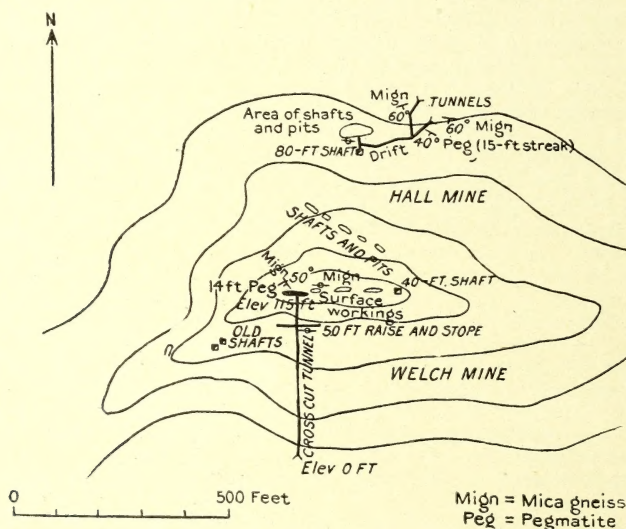


FIGURE 3.—Plan of Hall and Welch mines, Macon County, N. C.

ings and details of the geology, is shown in figure 3. At the Hall mine the tunnels on the northeast were started nearly at stream level and were carried in as crosscuts and drifts on the "veins" to the bottom of a shaft 80 feet deep. From a higher level in this shaft a crosscut leads to extensive workings on the north. These workings and the shaft have partly fallen in. Farther up hill a line of pits and shafts shows the position of another "vein." Still farther south along the summit of the ridge is another line of outcrop workings with a shaft 40 feet deep at the east end. Openings have been made for a distance of nearly 250 yards along this lead and assume a southwesterly course farther west along the ridge. More than 120 yards to the south and 115 feet lower down the hill a new crosscut tunnel has



been driven in, cutting the "vein" that forms the crest of the ridge and another "vein" about 60 feet south of it. The latter "vein" is 2 to 8 feet thick and has also been prospected along the outcrop. Drifts have been run both east and west along this pegmatite, and a 50-foot raise with stope has been made on the east side of the crosscut tunnel. The pegmatite forming the crest of the ridge is about 14 feet thick where cut by the tunnel. Two quartz streaks from 1 to 3 feet thick are inclosed in the pegmatite parallel with its direction. This pegmatite body cuts across the mica gneiss country rock in part, with a varying east-west strike and nearly vertical dip. The mica yield has come chiefly from the two outside feldspar streaks between quartz and mica gneiss walls, but a small amount has been obtained between the two quartz streaks. The mica obtained from these mines is of fine quality, with a clear "rum" color.

*Neal Bryson Mine.*—The Neal Bryson mine is 1 mile south of West Mills, on the east side of Little Tennessee River. The mine is in a small depression in a steep hillside. In this depression the soil has accumulated to a depth of several feet and carries mica from the breaking down of former pegmatite bodies. A small amount of "groundhog" mining has been done in this soil and debris for its mica content. The principal workings consist of an old shaft with drifts and stopes on the vein, a new 180-foot crosscut tunnel, and a shaft with other drifts. The mouths of the shafts are about 60 feet above that of the crosscut tunnel. The old stopes from the old shaft extend down to the level of the new tunnel. The drift from this tunnel to the east connects with the new shaft on this level and on a small level 15 feet above. The position of the workings, with details of the formation, is shown in figure 4.

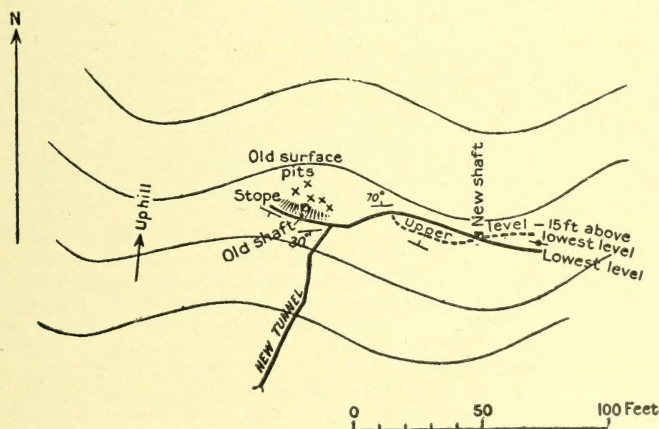


FIGURE 4.—Plan of Neal Bryson mine, Macon County, N. C.

The pegmatite has an irregular east-west strike, with varying dip that shows considerable warping. The dip ranges from vertical to  $70^{\circ}$  N. in one place and to  $30^{\circ}$  S. at the west end of the workings. The vein varies from one foot in thickness in one part of the workings to 12 feet in others. A quartz streak varying in thickness with the thickness of the pegmatite is included near the middle of the pegmatite where the latter is over 3 feet thick. The mica occurs in the feldspar between this quartz streak and the mica gneiss walls. At the east end of the tunnel the "vein" is richest next to the south wall. The quality of the mica from this mine is excellent.

*Campbell or Higdon Mine.*—The Campbell mine is about  $1\frac{1}{2}$  miles N.  $75^{\circ}$  W. of Cowee Gap, where the Webster-Franklin road crosses. Over a dozen tunnels have been run in on probably two or more "veins." The mine is in a shallow cove or hollow on a steep mountain side. The soil accumulation

in places in this cove is deep, especially over the lower part of the mine. This soil contains more or less sheet-mica debris from the disintegration of pegmatite veins. Mining through this soil is difficult, as land slides occur. One recent slip has taken place in the cove in which a large body of the soil has dropped down about 10 feet. This slip is evident on the surface above the workings. At the time of visit (1906) there were two tunnels open in hard-rock formation, an old one in slide material was being cleaned out, and another 250 feet long at the base of the old workings was being driven in search of "vein" matter. This tunnel was very crooked, because it was necessary to avoid loose slide rock in several places. In one of the hard-rock tunnels a good pegmatite "vein" about 10 feet thick, was encountered. It contained a 2- to 5-foot quartz streak within its mass. The yield of mica was from the partly kaolinized feldspar streaks between the quartz ledge and mica gneiss walls. The mine has yielded a quantity of fine quality of mica with a clear "rum" color.

*Beasley Mine No. 1.*—The Beasley mine No. 1, also called "Bradley butt," is one-half mile east of Mica City. It has been operated by a large open cut with a little stoping from its bottom and several tunnels at lower levels on the hillside. Some of these openings are on different "veins" from or branches of the main pegmatite worked in the open cut. The open cut is about 200 feet long and has a maximum depth of 30 feet. One of the tunnels below the cut was run in about 75 yards. The pegmatite was as much as 30 feet thick in one part of the open cut and pinched down into two small streaks 1 and 2 feet wide with 4 feet of mica gneiss between them at the east end of the cut. The country rock is biotite gneiss. The pegmatite strikes about east and west, with a dip of 85° S. near the outcrop and of 30° S. at a depth of 25 feet. The pegmatite cuts sharply across the gneiss and horses of gneiss are included within it. The rock formations are unaltered and very hard at this mine, requiring much blasting. Irregular segregations of massive quartz occur through the pegmatite. Portions of the feldspar have a greenish cast, caused by stains from the partial decomposition of a small amount of sulphides scattered through it. A large pocket of mica, yielding a quantity of large sheets of high grade mica, is reported to have been found in the open cut. Much of the mica from the Beasley No. 1 mine is of excellent quality, with a clear "rum" color, but some of greenish color with an "A" structure was found in one of the lower openings.

*Beasley Mine No. 2.*—The Beasley mine No. 2, is about one-half mile south of Beasley mine No. 1, on the south side of a high ridge. The deposit has been opened by prospect pits for about 150 yards along the outcrop and by a tunnel with drifts, large stopes, and an incline shaft connecting with the stopes. The lowest tunnel entering the drifts to the stopes is about 75 feet lower than the mouth of the incline entering the stopes on the hillside above. The drift from the end of the tunnel is about 150 feet long and the farther half of it opens up into the stope above. The country rock is mica gneiss, which has an east-west strike and a dip of 65° S. at the mouth of the tunnel. The pegmatite strikes about N. 70° W., with a dip of 40° SW. The pegmatite is more than 15 feet thick in places, but the entire thickness was not removed in mining. The mica evidently occurred more plentifully within the mass than along the walls. In 1906 these old works were being cleared out preparatory to developing new ground. The mica from this mine is of fine quality. A small amount of biotite is associated with it.

*Wincoff Mine.*—The Wincoff or old Jacobs mine is 2½ miles northwest of Franklin. It has been opened for a distance of about 300 yards, in a northwest-southeast direction, by numerous shafts, pits, cuts, and tunnels. A plan of the workings is given in figure 5. At 1 remains of ancient workings were found, and later four shafts with "groundhog" tunnels were made. The pegmatite has a width of about 25 feet where exposed in these openings and is badly decomposed. The principal developments to the northwest were made by the last owner, Mr. Wincoff, before 1907. At 2 a pegmatite ledge was exposed in an open cut varying in thickness from 5 feet at the surface to 8 feet in the bottom of the cut. At 3 a shaft 35 feet deep en-



countered a pegmatite ledge inclosing quartz bands. At 4 and 5 two shafts reported to be 65 feet deep exposed a pegmatite ledge varying from 2 to 8 feet in thickness and containing quartz bands. At 6 a shaft about 40 feet

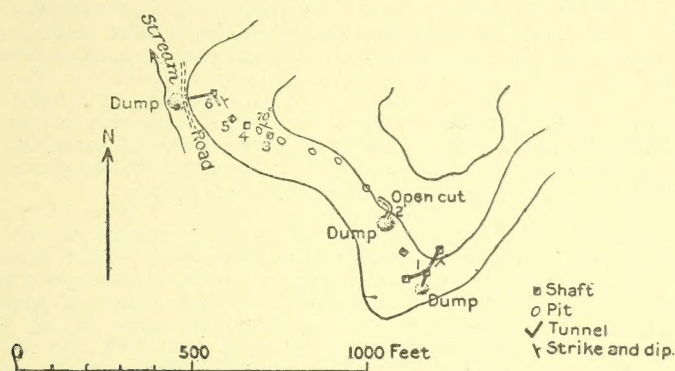


FIGURE 5.—Plan of Winecuff mine, Macon County, N. C.

deep connecting with a crosscut tunnel and drifts encountered a pegmatite composed of a 6-foot streak of quartz with small feldspar streaks along the sides.

The workings at 1 are probably on a different pegmatite body from those to the northwest, though it is possible that a swing in the strike (northwest) at 1 might bring the same pegmatite ledge to 2 and other points. The strike and dip of the pegmatite are shown by appropriate marks at 1, 3, and 6. The banded appearance of the "vein" is marked in openings 3 to 6 by streaks of quartz and mica schist, in the pegmatite and parallel with its walls. The principal field of mica has been from the workings at 1 and 4 to 6. Possibly the same pegmatite was opened at the old Harris or Raby mine, about 75 yards northwest of and across a branch from the Winecuff mine. The mica from each of these mines has a clear "rum" color and is of fine quality.

#### JACKSON COUNTY.

*John Long Mine No. 1.*—The John Long Mine No. 1 is one-fourth of a mile northeast of the mouth of Wayehutta Creek, 4 miles southeast of Web-

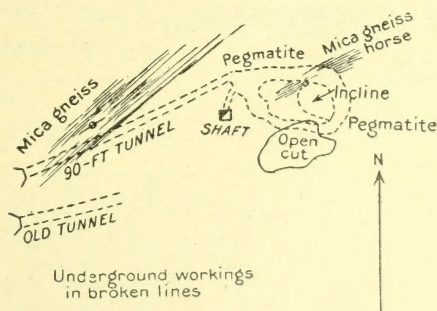


FIGURE 6.—Plan of John Long mine, No. 1, Jackson County, N. C.

ster. It has been worked by a tunnel 90 feet long and nearly on the strike. At this distance the tunnel forks into two branches, which come together again about 45 feet farther on. Where the tunnels join, an incline working

was sunk under the large pillar left between them. There has been some open-cut work on the outcrop—a shaft which passed to one side of the underground workings and an old tunnel now caved in. The position of the workings is shown in figure 6, p. 45. The pegmatite formation has decomposed badly and is so soft that the tunnels require careful timbering. The greater part of the ground left between the branching tunnels is pegmatite, with the exception of a horse of mica gneiss several feet thick. The pegmatite contains quartz streaks or ledges lying parallel with its general course. Several large blocks of mica and many small ones were seen in the kaolinized feldspar. This mica was more or less fractured and contained a considerable quantity of clay stains between the laminae. The mica has a clear "rum" color where the crystals have not been clay stained.

*John Long Mine No. 2.*—The John Long mine No. 2 is at the mouth of Wayehutta Creek. The mine has been opened by a crosscut tunnel 60 feet long, driven from a point slightly above the creek level, with a 40-foot drift on the "vein." The latter has been stoped out to the surface for a distance of 20 feet and has been removed to a depth of 10 feet below the level of the tunnel. The country rock is biotite gneiss striking about N. 25° E. with a nearly vertical dip. The pegmatite is 10 to 12 feet thick and includes a number of streaks of gneiss. The mica occurs more plentifully along the east wall of the pegmatite and this portion is removed in mining to a width of 5 to 8 feet. The streaks of included gneiss split the pegmatite into lenses and bands from a few inches to a foot or two thick. The formation is fresh and hard from the surface down and requires much blasting. The mica is of fine clear "rum" color. It is reported that during three months of 1906 \$400 worth of rough mica was obtained.

*Painter Mine.*—The Painter mine is 2½ miles S. 65° E. of Sylva, on the northwest slope of a small mountain. The mine was opened many years ago by two shafts, with drifts, and a tunnel at a lower level but not connecting with the shafts. Later, more systematic operations resulted in a tunnel 175 feet long opening into a stope nearly 200 feet long. The stope was carried to a depth of 40 feet below the tunnel level and some 20 feet above, being very irregular in shape. A longitudinal section through the "vein" showing the shape of the workings is given in figure 7. The country rock is

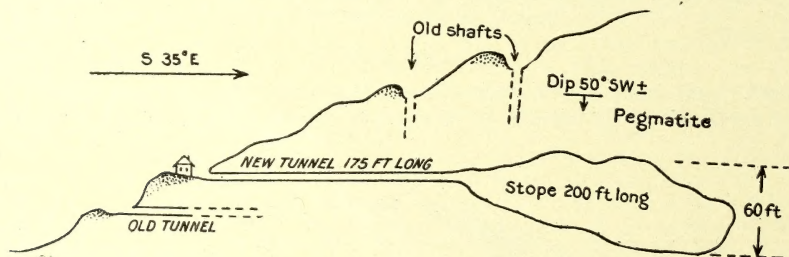


FIGURE 7.—Section in plane of the "vein" at the Painter mine. Jackson County, N. C.

garnetiferous mica gneiss which has a strike of N. 35° W. and a high dip to the southwest. The pegmatite is approximately conformable with the inclosing gneiss. The "vein" varies from 2 to more than 15 feet in thickness at the end of the stope. A large quartz streak in the middle of the pegmatite in this stope is left as a foot wall for the workings. The mica streak lies between this and the hanging wall. It is possible that more mica might be found by further prospecting the feldspar streak between the quartz streak and the foot wall. Several large blocks of mica were exposed in the face of the stope at the time of examination (1905). The mica is mostly clear and of good quality, though a small amount of "specked" material was seen on the dumps. A strip of "ruled" mica of fine clear "rum" color saved as a specimen at the mine measured 2 by 15 inches. It exhibited the "A" structure slightly at each end, but was perfectly sound in the middle.



The mine is equipped with a hoisting engine and pump at the mouth of the tunnel and a track in the tunnel and stope.

*Piney Mountain Mine.*—The Piney Mountain mine is 1 mile north of Sugarloaf Mountain, in the summit of a small knob. The mine has been worked by open cuts, crosscut tunnels, drifts, stopes, and shafts. The positions of these workings are shown in plan view in figure 8. Evidently work

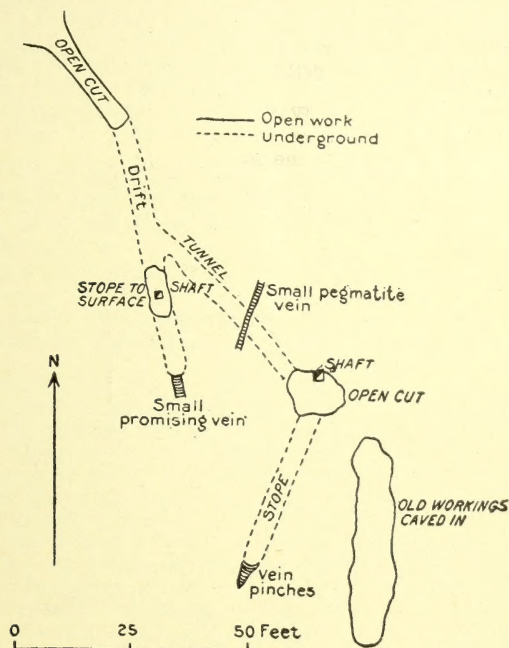


FIGURE 8.—Plan of Piney Mountain mine, Jackson County, N. C.

has been done on three separate "veins" with varying, nearly northerly strike and approximately vertical dips. The westerly "vein" was followed from the open cut by a drift with a stope to the surface and a shaft in the bottom of the open stope. At the end of the drift the pegmatite was only 2 feet thick, but it was still fairly rich in mica. An open cut with a shaft in the bottom was made on the middle vein and a stope driven southward from the cut. A crosscut tunnel was also run to the drift on the west "vein" for the easy removal of waste. The easterly "vein" was the first opened and the workings on it have fallen in badly. It is reported that the mica-bearing part was stoped out.

The country rock is mica gneiss. It is cut by small masses and streaks of pegmatite in various directions. The pegmatite worked for mica ranges from 1 to 12 feet in thickness. A quartz streak is generally present in the interior of the pegmatite and oriented parallel with its walls. This mine is reported to have been a good producer of mica.

*Big Flint Mine.*—The Big Flint Mine is about half a mile west of south of Wesner Bald and about 200 feet above one of the forks of Cabin Creek. The mine takes its name from the immense boulder-like mass of white quartz that marks its outcrop. Several "groundhog" pits and tunnels have been made under the quartz mass, to the west of it, and on the hillsides below it. Large masses of quartz outcrop in the branch about 100 yards east of the mine. The country rock is mica gneiss with an east-west strike and a dip to

the south. The "Big Flint" mass of quartz is about 40 feet across and at least 25 feet thick. It does not appear to have any connecting mass below, for excavations have been made under a large portion of it from each side and have encountered only kaolin and mica. The under side of this quartz mass is rounded and is composed of overlapping lenticular and shell-like masses of quartz from an inch or two to a foot thick. Fine partings of mica have developed in the seams between these lenses. The feldspar, entirely altered to kaolin, is massive under the quartz mass. This kaolin also shows lense-shaped layers with parting seams or slips about parallel with those in the quartz. In the openings west of the quartz mass the feldspar formation is massive and contains streaks rich in small mica crystals. A wall of mica gneiss exposed here, probably a horse, has a north-south strike and dips 45° E. The mica obtained from this mine is principally in small sizes, but is of light color and good quality.

*Wayehutta Kaolin and Mica Mine.*—The Wayehutta kaolin and mica mine is on the west side of Black Mountain, near the head of Wayehutta Creek and 3 miles due south of Willetts. The mine is 300 or 400 feet above the

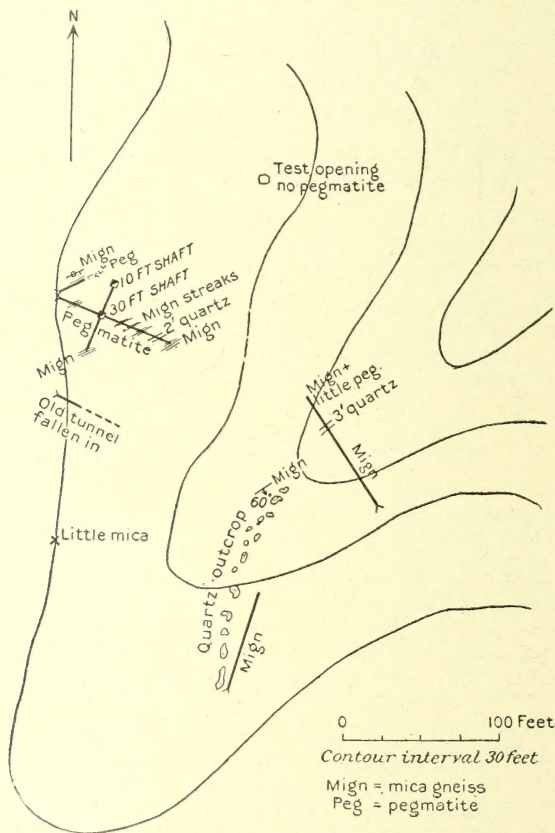


FIGURE 9.—Plan of Wayehutta kaolin and mica mine, Jackson County, N. C.

valley, on the side of a steep ridge, near and on the top. Developments consist of an 80-foot tunnel with 45 feet of crosscutting and two inferior shafts on the pegmatite, with several other trial tunnels and openings. The latter do not expose the main body of the pegmatite. Figure 9 shows the position



of the different openings and the formations encountered in each. The country rock is mica gneiss with a strike of N. 60° to 70° E. and a southeasterly to vertical dip. The pegmatite contains in places streaks or horses of mica gneiss, and its contact with the gneiss is highly irregular. A massive quartz vein 2 feet thick was encountered near the southeast side of the pegmatite. Another quartz ledge, 3 feet thick, outcrops on the top and opposite side of the ridge, 40 yards southeast of the kaolin deposit. Workings on this quartz ledge show that it is not directly connected with the main body of the pegmatite. The feldspar of the pegmatite is thoroughly decomposed and in places has altered to large masses of pure kaolin. The upper 12 feet of the 30-foot interior shaft and 9 feet of the 10-foot shaft were cut through kaolin. A small amount of clear "rum" colored mica was found in parts of the workings.

*Cedar Cliff Mine.*—The Cedar Cliff mine is one-fourth of a mile east of the Deep Gap of Black Mountain. The mine is located in the face of a cliff of hard rock. It has been operated by an open cut nearly 60 feet high and 5 to 25 feet back in the face of the cliff. The country rock is garnetiferous mica gneiss, striking N. 45° E. with a northwest dip. The pegmatite cuts across the gneiss with a strike of N. 10° E. and nearly vertical dip. The "vein" varies from 1 to 3 feet in thickness and contains streaks of quartz parallel with its walls. Other pegmatites outcrop in the cliff and some show indications of mica in commercial sizes. The mica is clear and of good quality.

*Leon Hooper Mine.*—The Hooper mine is on the road along Moses Creek, a little more than a mile above its mouth. It was worked by an open cut 60 feet long and 10 to 18 feet deep along the "vein" close to the roadside, and a crosscut tunnel under the road to remove waste. The country rock is mica gneiss, which strikes N. 50° E. with a dip of 75° SE. The pegmatite is conformable with the inclosing gneiss and has a thickness ranging from 5 to 12 feet. In the thicker portions the whole of the pegmatite was not removed, only that containing a "lead" of pockets in the interior being mined. The mica gneiss is very schistose near the contact with the pegmatite. The latter contains a few sheets of quartz lying parallel with its walls. One of these quartz streaks near the northeast end of the cut was 18 inches thick, pinching out in a distance of a few feet. The mica at this mine has a dark-brown color in sheets one-sixteenth of an inch or more thick, but is clear when split into thin sheets. Part of it is a little "specked."

*The Pinhook Gap Mine.*—The Pinhook Gap mine is on the southwest side of the gap of that name in Tennessee Ridge. This mine has been worked extensively at various times. During 1905 a new deposit was opened about 250 yards southwest of the old workings. C. H. Wolford operated the Pinhook Gap mine during part of 1905 and 1906. He reported a production of about 600 pounds a week of merchantable sheet mica during part of this time.

The older workings consist of a large open cut with a crosscut tunnel driven from its southwest corner a short distance out into the pegmatite, and thence turning along the strike of that rock. This connects with a tunnel driven in from the southwest at a lower level. Other short tunnels were driven from the open cut in various directions. Numerous pits and crosscut trenches were made a short distance to the northeast. The pegmatite is irregular in shape, swelling from a thickness of a few feet to the southwest to 30 feet in the open cut and nearly 50 feet northeast of it. Quartz segregations and streaks are scattered through it. On the east side of the open cut a mass of boss or garnet-mica rock or "mica capping" several feet across was encountered. It was composed of bunches of "wedge" shaped mica crystals showing the "A" structure, with coarse garnets scattered thickly through it. The mica crystals ranged from a fraction of an inch to 3 inches across and the garnets from small size to nearly 2 inches in diameter. The garnets constitute at least 25 per cent. of the whole mass and are found to be fresh and firm on crushing, even if apparently badly weathered on the surface.

Operations at the later workings consist of a shaft 30 feet deep with a drift on the vein and a crosscut tunnel from the hillside below. The country rock is mica gneiss, which strikes N. 40° E. with a dip of 40° NW. The pegmatite is conformable or nearly so with the strike of the gneiss. The outcrop of the "vein" is marked by large masses of quartz. These quartz masses are irregular in shape and some of them pinch out at small depth. The feldspar part of the pegmatite is also irregular in shape. It is 6 feet thick at the surface in the shaft.

The mica from the Pinhook Gap mine has a brownish color and is partly "speckled." Large-sized sheets are sometimes obtained, however, in which the "specks" can be eliminated by splitting.

*Roda Kaolin and Mica Mine.*—The Roda mine is on the south side of Tuckaseegee River opposite the mouth of Caney Fork. The deposit lies in the summit of a low rounded hill and has been proved on three sides by tunnels and pits. The relative position of these workings is shown in figure 10 (a). The deposit has a large outcrop of massive, coarse, sugary quartz over it, and this quartz was also encountered in the workings. The first work was for mica on the south side of the hill and in this the large mass of kaolin was exposed. The principal development is a crosscut tunnel on the west side. This cuts masses of both gritty and very good kaolin and sugar quartz. A 40-foot shaft was sunk from the interior of this tunnel and encountered kaolin through its whole depth. A diagram of this tunnel is shown in figure 10 (b). The tunnel on the east side of the deposit was driven 18 feet in a mass of fairly pure kaolin after passing through a number of feet of soil.

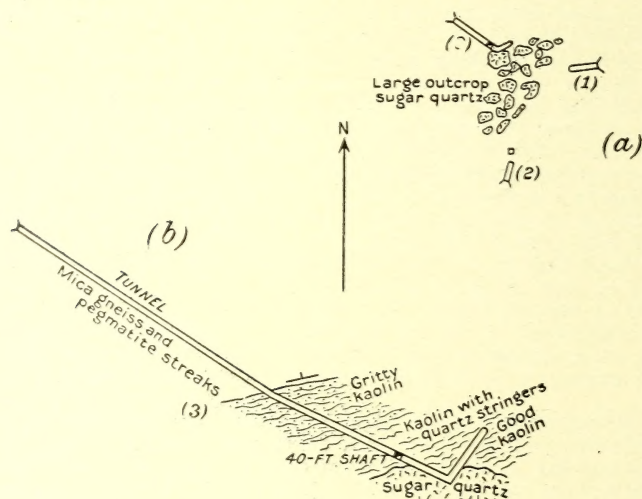


FIGURE 10.—Roda kaolin and mica mine, Jackson County, N. C. (a) Plan; (b) details of tunnel 3 shown in (a).

*Jim Wood Mine.*—The Jim Wood mine is on the west side of Wolf Creek, about a quarter of a mile above the Wolf Mountain road. It was worked by an open cut about 50 feet long and an open incline stope 20 feet deeper from its bottom. The country rock is mica gneiss with a layer of gritty talc schist a few feet southeast of the pegmatite. The latter is conformable with the inclosing gneiss and strikes N. 70° E. with a dip of 50° N. The "vein" was rich in mica near the surface for the whole length opened, but was sufficiently rich to work for a length of 8 feet only near the bottom of the incline. At the bottom of the incline the "pay streak" became longer again.



The whole thickness of the pegmatite was not removed, only that portion carrying the mica streak being mined. The workings and geologic relations are shown in cross and longitudinal sections in figure 11 (a) and (b). The mica has a dark-brown color in sheets of sufficient thickness, and part is "speckled." Some of the crystals are well developed and others are partly "wedge" shaped.

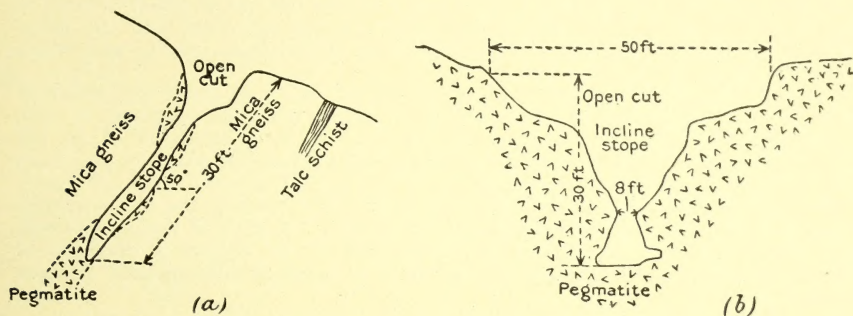


FIGURE 11.—Jim Wood mine, Jackson County, N. C. (a) Cross section, (b) section in plane of the "vein."

*Gregory Mine.*—The Gregory mine is 1 mile S. 20° W. of Panther Knob, near the top of the ridge running south from that mountain to the Cullowhee Mountain divide. It was worked by an open cut about 50 feet back into the mountain side. On one side of the cut a deeper cut and room had been stoped out. The deepest part was probably not over 25 feet deep. The country rock is mica gneiss, which strikes N. 30° E. with a vertical dip. The pegmatite cuts across the gneiss with a strike of about N. 50° W. and a ver-

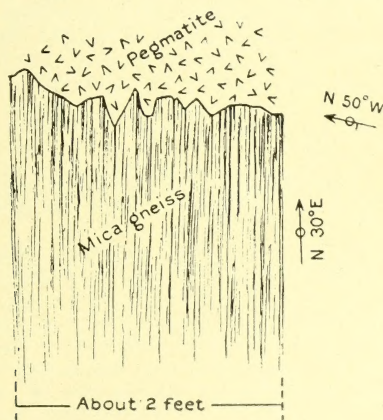


FIGURE 12.—Uneven contact of pegmatite and mica gneiss at the Gregory mine, Jackson County, N. C.

tical or high southerly dip. It is at least 10 feet thick in places and contained large quartz streaks and masses, one 4 feet through. The contact with the mica gneiss is not sharp, and in one exposure along the southwest wall was jagged, as shown in figure 12. Small mica is plentiful in parts of the "vein" and some good-sized crystals were left in a pillar over the stope. The mica has a "rum" color and is of good quality.

**Bowers Mine.**—The Bowers mine is 1 mile S.  $30^{\circ}$  E. of Panther Knob. The mine is in the east face of a steep mountain side, almost a cliff. It was worked by an open cut, not as wide as the pegmatite, 40 feet long into the mountain side, and with a maximum depth of 35 feet. A shaft was sunk from the inner end of this cut. The country rock is hard mica gneiss which strikes N.  $55^{\circ}$  E. and dips  $70^{\circ}$  NW. The pegmatite carries a large amount of quartz and is very hard. Near the top of the cut the pegmatite forks, a small streak, worked out for several feet, running westward and the other streak running northwestward. The mica is of excellent quality and has a fine "rum" color.

**Judge Ferguson Mine.**—The Judge Ferguson mine is about  $5\frac{3}{4}$  miles S.  $55^{\circ}$  W. of Webster. It is one of the older mines and was reopened in 1906 by Mark Bryson. The workings at the time of visit consisted of an old open cut, two old shafts from the surface, and an interior shaft 55 feet deep at the end of the crosscut tunnel, with drifts and stopes. The new work consisted of a tunnel 180 feet long run irregularly toward the old workings and at a level 65 feet lower than the old tunnel. A plan of these workings is given in figure 13. The new tunnel had to be driven a distance of about 25 feet to cut the pegmatite, which it is reported subsequently to have done.

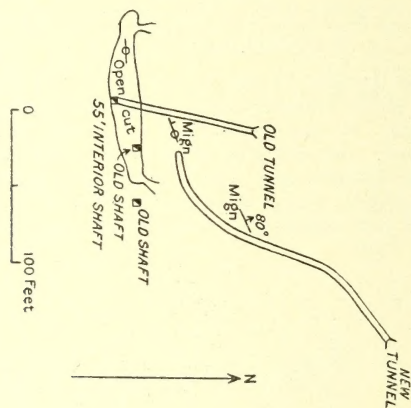


FIGURE 13.—Plan of Judge Ferguson mine, Jackson County, N. C. Mign., Mica gneiss.

The pegmatite strikes about east and west, with a vertical dip cutting across the mica gneiss country rock at a small angle. The latter has a strike slightly north of east and an approximately vertical dip. The pegmatite is about 12 feet thick in the old workings and contains a large quartz streak through part of its course. The mica occurs in the feldspar streaks between the quartz and wall rocks. It has a clear light color and much of it is of good quality, though a portion has the "A" structure.

**J. H. Rochester Mine.**—The Rochester mine is one-third mile southeast of Ocala post-office. It comprises two workings on different pegmatite bodies. In the one to the northwest an incline had been run down on the "vein." The country and wall rock at each opening is pegmatized mica gneiss striking N.  $30^{\circ}$  E. and dipping  $50^{\circ}$  SE. The pegmatite is conformable with the inclosing gneiss and about  $3\frac{1}{2}$  feet thick. About four-fifths of it, as exposed, consists of quartz. The mica is more plentiful near the walls of the pegmatite.

The principal work was done 75 yards to the southeast and consisted of an open cut 10 to 20 feet deep and 50 feet long on the outcrop, with a cross-cut tunnel and drifts, about 100 feet in all, at a lower level and under the



open cut, as shown in figure 14 (a) and (b). The pegmatite is from 1 to 5 feet thick, and conformable with the inclosing gneiss. Massive quartz is more or less prominent in different parts of the pegmatite. The mica is clear and has a dark-brown color with a tinge of green.

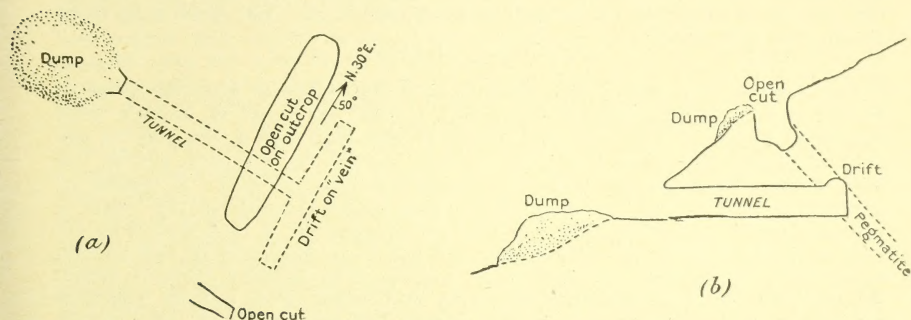


FIGURE 14.—J. H. Rochester mine, Jackson County, N. C. (a) Plan view; (b) cross section.

#### TRANSYLVANIA COUNTY.

**Bee Tree Fork Mine.**—The Bee Tree Fork mine is on the hillside opposite the mouth of Bee Tree Fork, on the headwaters of French Broad River. It was opened some years ago by Tarry McCall, and after lying idle many years was reopened in 1905 by C. H. Wolford. It has been operated by an open cut 50 feet long and 35 feet deep at the deeper end in the hillside. The cut is but little wider than the thickness of the "vein." The country rock is mica gneiss, which strikes about northeast with a dip of 45° NW. The "vein" has an irregular easterly strike with a dip varying from 45° to 80° N., cutting across the country rock with a sinuous course. The pegmatite ranges from 2 to 8 feet in thickness and is composed largely of quartz with smaller amounts of feldspar and mica. A small amount of pyrite and pyrrhotite is scattered through the rock. The mica has a clear "rum" color and is of good quality.

**Reed Mine.**—The Reed mine is 1 mile N. 60° E. of Montvale, and 2¼ miles S. 20° E. of Sapphire. It is owned by Dr. Robert Grimshawe, of Montvale. The mine has been worked by several tunnels at different levels, the greater part of which have fallen in. One 30-foot tunnel was driven in on a 5-foot "vein," which had a north-south strike and a dip of 30° W. This pegmatite is irregularly conformable with the inclosing mica gneiss country rock. It has a 2½-foot quartz streak in the middle with mostly feldspar on each side. About 75 feet to the north, on the opposite side of a small valley, the same "vein" has been worked by two levels (now stoped out between). One of these levels was driven back about 100 feet. The pegmatite had a strike of about N. 20° E. and a dip of 35° NW. in this tunnel. It had pinched down to about 18 inches in thickness with small scattering quartz lenses in it at the end of the tunnel. The mica from the Reed mine has a dark color and in part is "specked" with magnetite.

#### HAYWOOD COUNTY.

**Shiny Mine.**—The Shiny mine is near the head of Allen Creek, 1¼ miles north of Richland Balsam Mountain. It is 450 feet above the creek in the steep, cliff-like face of the west valley wall. Access was obtained over a rough trail and several sets of ladders. The workings consist of an open cut nearly 200 feet long in a north-south direction along the side of the mountain and up to 25 feet deep. The country rock is very hard garnet gneiss, which has a northerly strike with nearly vertical dip. The pegmatite is conformable with this and pinches and swells from a few inches to sev-

eral feet in thickness, with streaks branching out from it. The pegmatite contains quartz masses and streaks. Pyrrhotite is scattered through both the country rock and part of the pegmatite. The mica is rather thick in parts of the "vein," though only small-sized crystals were left exposed from the last operations. Sheets measuring 5 and 6 inches across were seen at the old trimming house in the valley below the mine. The quality of these sheets was very good.

#### BUNCOMBE COUNTY.

*New Balsam Gap Mine.*—The New Balsam Gap mine is near the head of North Fork of Swannanoa River, about 1 mile southeast of Balsam Gap. The mine is on the face of a cliff about 70 feet high and a few feet to one side of a waterfall over the cliff. It was worked by an open cut at the foot of the cliff, about 60 feet long, extending into the cliff. A tunnel or stope 15 or 20 feet high was then driven back under the cliff on the "vein" a distance of 70 feet. The full width of the pegmatite, 6 to 8 feet, was removed in the tunnel, and the waste was left to accumulate in the bottom as a floor for stopping out the "vein" above. The country rock is much-folded biotite mica gneiss striking north and south, with a high irregular dip to the west. The pegmatite cuts across the schistosity of the country rock with a strike of N. 45° E. and a nearly vertical dip. The pegmatite is very irregular in size and in one portion exposed in the roof of the tunnel it

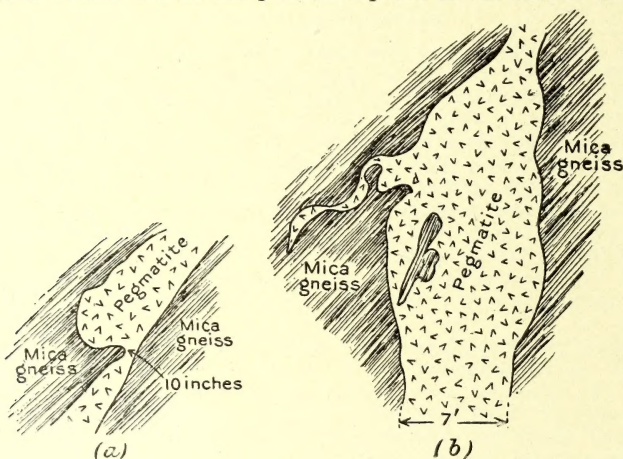


FIGURE 15.—New Balsam Gap mine, Buncombe County, N. C. (a) Section showing pegmatite pinched down to 10 inches and elbowing out abruptly; (b) irregularity of pegmatite exposed in end of tunnel; lenticular-shaped cross section with small side stringer and horse of mica gneiss.

pinches down to about 1 foot in width but abruptly elbows out again to several feet, as shown in figure 15 (a). The irregularity of the pegmatite is further shown by the exposure in the end of the tunnel, of which figure 15 (b) is a vertical cross section. The pegmatite pinches down in the upper part, is large in the middle, and smaller again at the bottom. On the west side there is an elbow in the "vein" with a small arm of pegmatite branching off into the mica gneiss. An irregular-shaped horse of gneiss was included in the "vein." The pegmatite is composed of the usual minerals segregated out into coarse masses in places. The quartz and feldspar occur in masses 2 or 3 feet thick, and the mica is richer in some portions than in others. One place in the roof where the pegmatite pinched down to a width of 2 feet carries abundant mica. The mica is good and has some biotite associated with it.



**Connally Mine.**—The Connally mine is 4 miles west of north of Black Mountain station, on the east side of North Fork of Swannanoa River. The country rock is diorite or hornblende gneiss, carrying mica gneiss bands. The mine was formerly opened by cuts and shafts on the hillside about 100 yards above the entrance to a new tunnel. The outcrop of the pegmatite at the old workings was marked by much massive quartz. A new shaft had been sunk near the old workings and pegmatite was encountered. The new tunnel was driven in an easterly direction for nearly 200 feet. Side tunnels were run near the end, as shown in figure 16, A. Irregularities in the formation were encountered at several places. At 1, figure 16, A, a small lens or streak of pegmatite cuts across the hornblende gneiss walls of the tunnel. At 2 there is a vertical contact of hornblende gneiss on the left and pegmatite on the right. For a number of yards at 3 there is hornblende gneiss in the bottom of the tunnel and pegmatite in the upper part. At 4 the pegmatite gives out and hornblende gneiss is encountered. The irregular nature of this contact is shown in figure 16, B, which represents the section (a) exposed on the south wall. The feldspathic part of the pegmatite forks into mica gneiss. At 5 and 8 there are irregular streaks of massive quartz. Between 6 and 7 there is a vertical contact between pegmatite and hornblende gneiss. At (b) there is another large irregular mass of quartz included in or a part of the pegmatite. It is shown in cross section in figure 16, C, as it appears in the north wall of the tunnel.

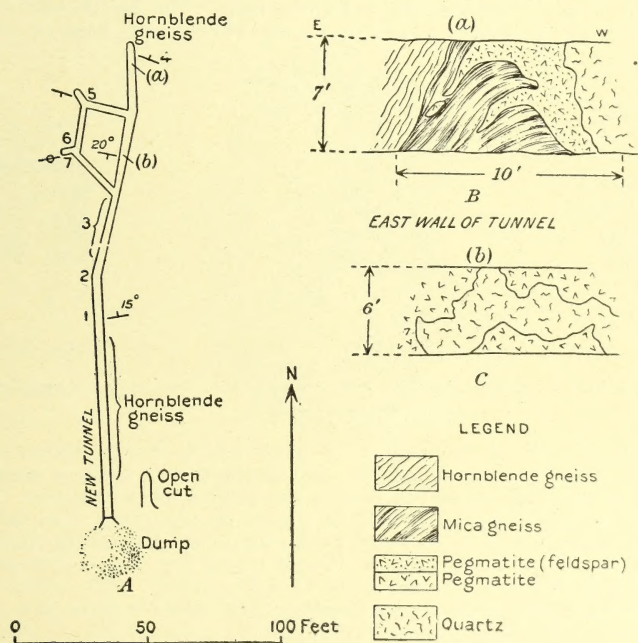


FIGURE 16.—A, Plan of Connally mine, Buncombe County, N. C.; reference figures described in text. B, section in east wall of tunnel at (a) in A. C, Section in east wall of tunnel at (b) in A.

The feldspar of the pegmatite is badly kaolinized, and it was the intention of Colonel Connally to test the deposit for kaolin. The mica occurs chiefly in the kaolin along the quartz masses and is much crushed in many places. The quantity of mica found in the new tunnel was not large, but the old workings on the hill above are reported to have yielded well. The mica obtained was of a clear light "rum" color and good quality.

## YANCEY COUNTY.

*Poll Hill Mine.*—The Poll Hill mine is  $1\frac{3}{4}$  miles west of south of New-dale, on the east side of South Toe River, just across the river from the Gibbs mine. This mine consists of two parts, both of which have been operated intermittently and actively since 1906. The part near the bank of the river was worked by the Burleson Mica Company, and that higher up on the hill by Hall Brothers & Burleson. The part near the river was being cleaned out at the time of visit and was equipped with a steam pump and hoist. The workings consist of an incline about 20 feet deep on the pegmatite and a tunnel to the northeast of it. The country rock is mica gneiss which strikes about N.  $75^{\circ}$  E. and dips  $55^{\circ}$  S. The pegmatite is only approximately conformable with the gneiss, and so far as seen varies from 10 to 15 feet in thickness. It contains numerous small horses or streaks of mica gneiss or schist included parallel with its walls.

The upper part of the mine has been worked at a number of places, and in such positions as to show an irregular pegmatite formation or several masses of pegmatite. The last operations had been in progress about one year at the time of visit and the nature of the work is shown in figure 17, A. A 70-foot tunnel was driven in a N.  $75^{\circ}$  E. direction on a mica "vein." From this an incline was run in a southwesterly direction on a dip of about  $35^{\circ}$ . The incline was about 70 feet long, 20 feet wide, and 10 feet high. A bench was left on the northwest side in barren rock. The waste and mica were hoisted from the incline by means of a hand whim at the head of the incline.

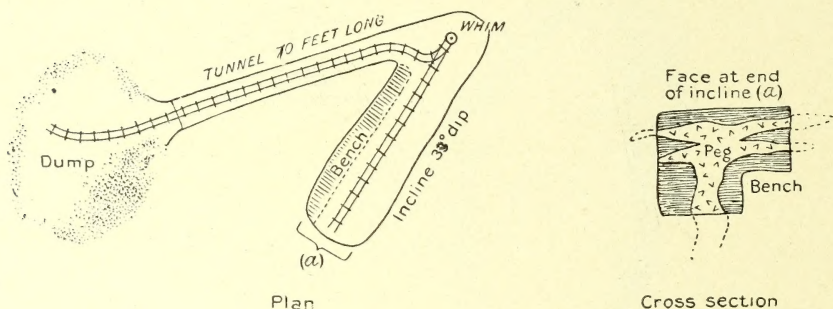


FIGURE 17.—A, Plan of Poll Hill mine, Yancey County, N. C. B, Cross section of pegmatite at end of incline at (a) in A.

The wall rock is biotite gneiss, through which the pegmatite cuts and into which it forks out. Figure 17, B, represents the vertical cross section of the pegmatite exposed in the face at the bottom of the incline. The position of the bench in barren gneiss is shown on the side. The incline was driven on the pegmatite where that rock was diverted from its course across the gneiss into lens-shaped masses. These lenses became smaller or pinched out in a short distance on each side.

The quality of the mica from the Poll Hill mine is good and the color a clear "rum."

*Aley Mine.*—The Aley mine is at the head of Browns Creek about 3 miles southwest of Micaville. It has been opened by at least three tunnels, one an incline, and by open cuts and a shaft 40 feet deep. The last work was that of the J. E. Burleson Company in 1904. The "vein" strikes N.  $15^{\circ}$  E. with a high easterly dip. It has been opened along its strike for a distance of nearly 100 yards up and down the slope of the mountain. The lowest opening is an old tunnel run in on the "vein" for drainage and development purposes. A shaft started higher up the hill to meet this old tunnel was never completed. At the time of visit a block of mica weighing nearly 100 pounds was found in the bottom of the shaft and several other



fine blocks of mica were found within 3 feet of the surface in a cut east of the shaft. The latter material may have been drift from the outcrop of the "vein" above, though it probably belonged to a second "vein" parallel to the first. A corresponding "vein" has been opened by an incline lower down on the hill above and east of the drainage tunnel. The mica from this mine has a rich "ruby" to "rum" red color and is of excellent quality for stove purposes.

*Hensley Mine.*—The Hensley mine is on Pigpen Creek about 2 miles west of south of Green Mountain. It is said that there were ancient workings at this mine. It was operated by the Hampton Mining Company in 1906, when the accompanying notes were taken. The mine was also worked at earlier dates by white people. The country rock is mica gneiss, with north-south strike and a nearly vertical dip. The pegmatite is conformable, or nearly so, with the schistosity of the inclosing rock. It occurs in lens-shaped masses 3 to 4 feet thick. The mine has been opened by two shafts, 40 and 45 feet deep and 15 feet apart, each one evidently having been sunk on a rich lens. In the space between the shafts, partly worked out, the overlapping of two lenses was well shown. (See fig. 18.) The gneiss and schist walls bend around the lenses. Fifty feet south of the shafts an open cut exposed a lens  $2\frac{1}{2}$  feet thick and about 15 feet long lying in the gneiss. Some blocks of mica many pounds in weight have been found. Part is clay and iron stained near the surface and is used for electrical purposes, and part has a clear amber color and is suitable for stove use.

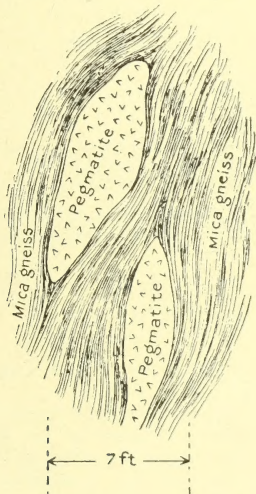


FIGURE 18.—Vertical cross section of pegmatite at Hensley mine, Yancey County, N. C.

*Young Mine.*—The Young mine is about 2 miles west of Boonford and 100 yards west of South Toe River. The mine has been opened by cuts, pits, tunnels, and shafts covering a width of more than 50 feet and for a distance of more than 200 feet. The workings extend from the south side over the top to the north side of a ridge about 100 feet high. The mine has been operated at several different times, the last time by the J. E. Burleson Company in 1904-5. The country rock is hornblende gneiss, biotitic near the contact with the pegmatite. The pegmatite outcrop crossing the creek on the south side of the ridge is about 100 feet wide. The strike of the formation is about N.  $35^{\circ}$  E. and the dip  $75^{\circ}$  SE. Streaks or horses of mica schist are included in the strike of the pegmatite and are parallel with it. The mica occurs in streaks parallel with these bands of schist, and the latter are left as walls to the workings in places. There is much small-sized mica

in the "veins" and some sheets of large size are reported to have been found. The quality is good and the mica is said to be especially fitted for electrical purposes.

#### MITCHELL COUNTY.

*Knob Mine.*—The Knob mica mine is a little more than 2 miles northeast of Spruce Pine. The pegmatite is inclosed in biotite gneiss or schist, with which it is roughly conformable. It strikes about N. 45° E. and dips about 40° SE. The pegmatite is coarsely crystallized next to the hanging wall and grades into fine-grained pegmatite or coarse granite on the lower side. Only the coarse pegmatite, called the "vein," is mined; this pinches and swells between 1 and 4 feet in thickness. The mine was first worked by open cuts on the outcrop and shallow inclines. Later a drift was run about 150 feet from the outcrop lower down on the hillside, and portions of the "vein" were stoped out to the open cut above. Figure 19 is a section in the plane of the "vein" and shows the nature of the work at the time of visit. The mica has a dark-green color and is "speckled," some abundantly, with dendritic spots of magnetite. Some crystals of large size are found, and one weighing 165 pounds was obtained at the time of visit in 1904. This block measured roughly 12 by 20 inches and was 30 inches thick. The mica was split and graded at the mine and shipped to electrical manufacturers. The splitting and rough trimming were done chiefly by women.

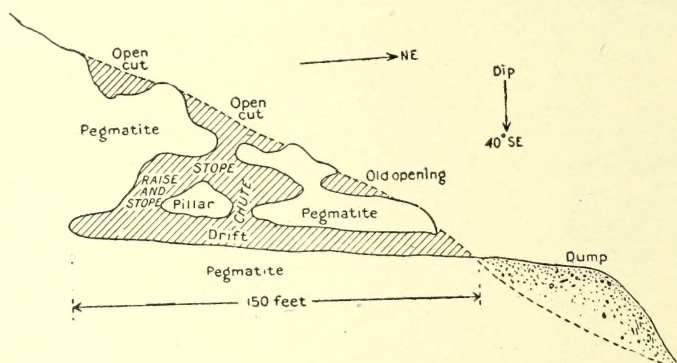


FIGURE 19.—Section in plane of pegmatite at Knob mine, Mitchell County, N. C.

*W. W. Wiseman Mine.*—The Wiseman mine is 2 miles northeast of Spruce Pine, on Beaver Creek. According to Mr. Mart Wiseman it was opened by James Wiseman and John Pendley in 1875. These men removed \$2,000 or \$3,000 worth of mica in one year's work. Later the mine was operated by Lum Blalock and Luke Lewis, and still later by other parties. About 1890 the mine went into the hands of the Southern Mica Company. The early workings consisted of a shaft carried down 30 feet and a tunnel 40 feet long along the vein.

At the time of visit (1904) the old workings had caved in badly, leaving a pit resembling an old open cut. The more recent workings of the Southern Mica Company were still open, however. A crosscut tunnel some 250 feet long had been driven into the "vein," along which drifts with extensive stoping were run. The country rock is highly schistose mica gneiss which has a varied dip and strike where it is cut by the tunnel. Several feet before the "vein" was reached the tunnel encountered coarse granite or fine-grained pegmatite, which grades into coarse pegmatite near the "vein." The coarse granite cuts across the schistosity of the gneiss, which trends N. 15° W. and has a 25° W. dip at the contact, whereas the granite has a strike more nearly east and west. Figure 20 shows the position of the workings and the relations of the rock formations. The crystallization of



the pegmatite as exposed in the walls of the drift is very coarse. Crystals of orthoclase feldspar 2 and 3 feet square had been cut through and the candle light reflected from the cleavage faces exposed outlined their shapes well. This mine is reported to have yielded large blocks of mica, one weighing about 2,000 pounds. Samarskite is said to have been found in masses of many pounds weight and broken up and lost before its nature was known.

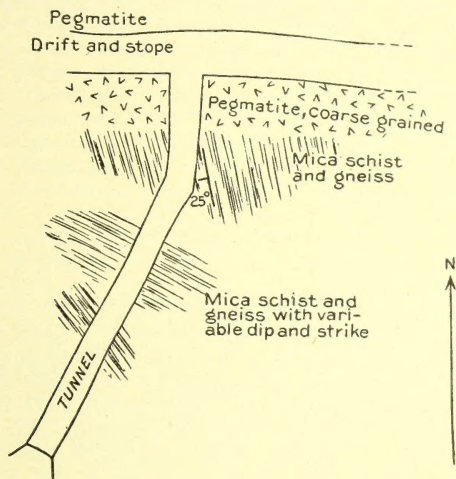


FIGURE 20.—Plan of the later workings at the W. W. Wiseman mine, Mitchell County, N. C.

*Charles Ridge Mine.*—The Charles Ridge mine is  $1\frac{1}{2}$  miles south of west of Plumptree and one-half mile west of Spear, about 200 yards south-

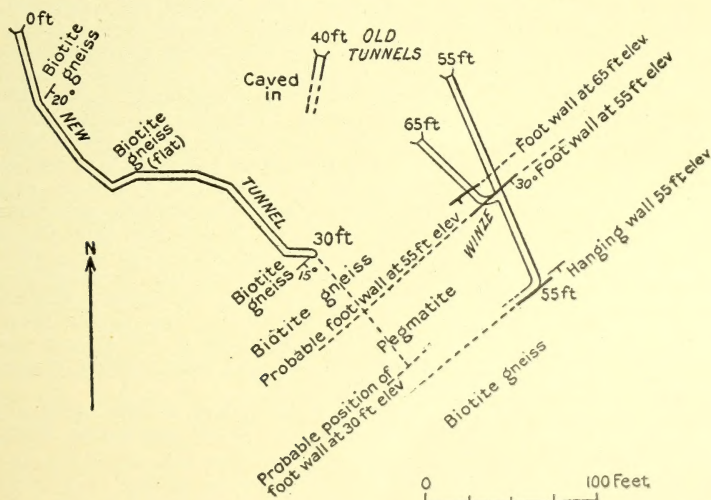


FIGURE 21.—Plan of Charles Ridge mine, Mitchell County, N. C.: figures give elevations above mouth of new tunnel. The position of the pegmatite is shown on the 55 and 65 foot levels; also the probable position at the level of the end of the tunnel.

east of the Justice mine. It was discovered about 1882 or 1883, by Ben Aldrich and worked by him for about six months. It has been operated at different times by Samuel Landers, Colonel Irby, and W. W. Irby. During 1905 and 1906 it was being reopened by A. Miller, C. W. Wisler, and J. W. Walters. The earlier work consisted of three tunnels and some pits. The new work consisted of a tunnel about 230 feet long at the time of visit. This tunnel was expensive, being run through very hard rock at the rate of about 3 feet a week and not being driven in a straight course. A plan of the workings and position of the pegmatite is shown in figure 21. The elevation of the new tunnel is given as zero, and the other three were run in about 40, 55 and 65 feet higher up and to the east. The new tunnel rises nearly 30 feet from its mouth to its head, thus losing much of the advantage gained through the position of its starting point. From measurements taken for the benefit of the miners it was found that the tunnel would have to be driven about 80 feet farther, if on a level, and in a direction S. 40° E., to strike the "vein."

The country rock is biotite gneiss, whose dip and strike vary, though in general the strike is northeasterly and the dip southeasterly. The pegmatite is large and is richer in mica near its walls than in the interior. There is a streak of highly foliated biotite schist 3 to 6 inches thick along the walls.

*Plumtree Mine.*—The Plumtree mine is one-half mile east of Plumtree, on Plumtree Creek. It was discovered by C. W. Burleson about 1870, and worked by him for about six months. It was later worked by Colonel English, Colonel Rorison, W. W. Avery, and others, and after a period of idleness was reopened again by the Burleson Brothers in 1906. The mine was operated by an open cut on the outcrop with a 30-foot incline and a tunnel or drift on the "vein" from a lower level. The country rock is of mica gneiss, interbedded with hornblende gneiss and the wall rock in mica gneiss. The pegmatite is conformable, or approximately so, with the inclosing formations and strikes about N. 25° W. with a dip of 10° to 25° NE. It is from 18 inches to 4 feet thick. The mica streak lies near the hanging wall and in places is separated from the wall by a quartz vein 3 to 5 inches thick. The crystals of mica are reported to be of good size, running up to 40 and 50 pounds in weight. Some of them are badly crushed and crumpled and suitable for grinding purposes only. The quality of the sound crystals is good. The sheets have a greenish cast and are in places slightly "specked."

*Johnson Mine.*—The Johnson mine is 2 miles east of Plumtree, on Plumtree Creek. The country rock at this mine is hornblende gneiss, biotitic near the contact with the pegmatite. The pegmatite is conformable, or nearly so, with the inclosing gneiss, which lies nearly flat in places and has gentle rolling folds in other places. The pegmatite varies from a few inches to 7 feet in thickness and is reported by the miners to be richest in mica where it is between 2½ to 4 feet thick. The main opening consists of a tunnel about 100 feet long, running N. 30° W. for 80 feet and then due north for 2 feet. For the last 30 feet of this tunnel the pegmatite is 7 feet thick and carries but little mica. Other tunnels have been run in different positions, following the directions in which the best mica was found. The rolling structure of the formation can be seen from the two dips and strikes. At the entrance to the main tunnel the strike was about N. 70° E. and the dip 20° N. A little way in the rock was nearly flat, and near the end of the tunnel the strike was due north and the dip 15° W.

The mica obtained from this mine is of the finest quality, with a rich "rum" color. One block is reported to have been found worth over \$100.

#### WATAUGA COUNTY.

*Dobbins Mine.*—The Dobbins mica mine is about 2 miles north of west of Elk Crossroads. It was operated extensively about 1890 and on a smaller scale about ten years later by the Blue Ridge Mica Company. There are two sets of workings about 250 yards apart, one at the foot of the hill and



the other on the top of the ridge to the northeast. The work near the road consists of five tunnels, with two shafts and other openings of "groundhog" nature. The tunnels have been run in at different levels on the hillside, in a space about 70 feet wide, showing a large pegmatite formation. These tunnels have directions varying from N. 25° to 45° E. and roughly show the trend of the pegmatite. The country rock is biotite gneiss and strikes between N. 30° and 40° E., with a nearly vertical dip. The pegmatite is conformable, or approximately so, with the inclosing gneiss. Portions of pegmatite rich in small mica were exposed in some of the workings, but in others there was little or no mica. The openings on the ridge consisted of three shafts and tunnels on each side of the summit. The openings were confined to a belt about 100 yards long in a direction N. 35° E. and about 40 feet wide. One deep shaft has been well timbered and was in a good state of preservation. The other openings had caved badly. But little mica had been left around these workings. The mica seen at the openings along the road was mostly of a dark-brown to greenish-brown color. Part was "speckled" and in "wedge" shaped blocks with the "A" structure. Some clear sheets were seen with good cleavage, but of rather dark color.

#### ASHE COUNTY.

*Hamilton Mine.*—The Hamilton mine is on the west slope of a mountain 2 miles northwest of Beaver Creek. It was re-opened by the Johnson-Hardin Company in 1907, since the accompanying notes were taken. The deposit was opened by two tunnels run into the hillside along the vein. In the upper and earlier one a shaft or winze was sunk 35 feet from a point about 20 feet in from the mouth of the tunnel. From the bottom of this shaft a curved tunnel was cut on vein material. The second tunnel was run at a lower level for a distance of 75 feet about south and did not connect with the upper one. This tunnel did not follow the pegmatite closely but seemed to cut across its strike at a small angle. The strike of the pegmatite appeared to be about N. 10° E. and the dip nearly vertical or to the east. The pegmatite is composed of feldspar and quartz in fairly coarse aggregates, with both muscovite and biotite in good-sized sheets. The muscovite mica is of excellent grade and has a clear light to dark "rum" color. The larger blocks of mica yielded sheets of 6 by 8 or 8 by 10 inches, but the principal production was in smaller sizes. The biotite occurs in sheets of nearly equal size and some of it is intimately intergrown with muscovite, the two having the same cleavage plane.

*North Hardin Mine.*—The North Hardin mine is on a ridge about 1½ miles west of Beaver Creek. It has been worked on a large scale and more systematically than is usual for mica in North Carolina. The mine was operated by two open cuts and other pits, three crosscut tunnels to the "vein," two shafts, and considerable drifting and stoping on the vein. These workings have proved the continuity of the pegmatite for a length of over 100 yards and show the thickness to vary from 3 to 8 feet. The country rock of the region is hornblende gneiss, but the mica deposit occurs in a smaller belt of biotite (probably granite) gneiss. The strike of the pegmatite is about N. 20° E. and the dip 75° to 80° E. At a place about 80 yards north of the main workings a shallow shaft was sunk in line with the "vein" on a small streak of pegmatite 18 inches thick, which was probably the main "vein" pinching out. Figure 22 shows the extent of the work open for examination at the time of visit. A large part of the stoping and drifts had caved in and could not be seen. The greater part of the vein above the tunnels shown in the figure had been removed, however, and future work should be directed to vein matter between old workings and to lower depths, easily attained with facilities for draining. Tunnel No. 3 is probably 50 feet higher than No. 1. The mine produced a large quantity of small block mica, yielding sheets 1 by 2 and 3 by 4 inches. A number of larger blocks, yielding sheets 6 by 8 and more inches square, were found with the smaller ma-

terial. Many small blocks of mica and one crystal over 10 inches thick and a foot wide was seen in the "vein," embedded in feldspar. The mica has a beautiful clear "rum" color and is of the best grade. Most of the blocks yield sheets of perfect quality.

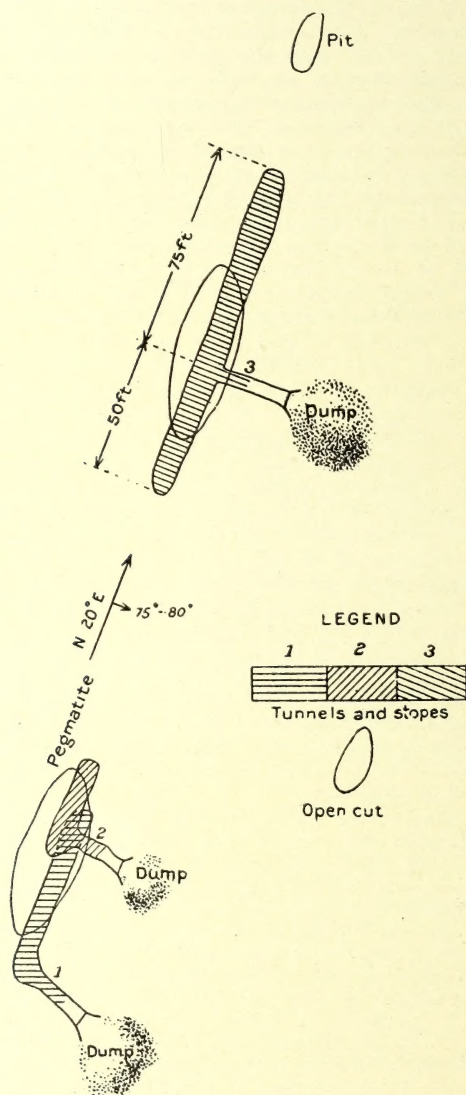


FIGURE 22—Plan of North Hardin mine, Ashe County, N. C.

*South Hardin Mine*—The South Hardin mine is near the top of a small mountain or hill about  $1\frac{1}{2}$  miles southwest of Beaver Creek. This mine was first opened by small pits, trenches, and a tunnel along the "vein." The surface workings were at the summit of the hill and the tunnel on the out-crop about 40 feet lower down to the northeast. The mine was later oper-



ated by a 30-foot shaft near the top of the hill and an open cut about 75 feet long and 10 to 20 feet deep on the "vein."

The country rock of the region, like that of the North Hardin mine, a mile to the northwest, is hornblende gneiss. The mica-bearing pegmatite is inclosed in a smaller mass of biotite mica gneiss included in the hornblende gneiss. The pegmatite is conformable with the schistosity of the inclosing formations, which strike due northeast and dip 50° SE. at this point. The pegmatite is about 7 feet thick as exposed at the surface. The interior is fine grained or like coarse granite, whereas along the walls the crystallization is much coarser. The principal mica yield is reported to have come from the foot wall, along which massive quartz streaks up to 2 feet thick were found. It is said that the crystallization of the pegmatite was coarser below a depth of 15 feet and the quantity of mica in it was larger than near the surface. The color of the mica obtained was a clear "rum" and the quality the best.

The quartz streaks along the foot wall of the pegmatite contained beryl crystals from less than an inch to 6 or 8 inches in diameter. These crystals were of good golden and aquamarine color, though cloudy and only translucent. It was found they made very pretty gems for scarf pins, cuff buttons, etc., when cut *en cabochon*.

#### RUTHERFORD COUNTY.

*Isinglass Hill Mine.*—The Isinglass Hill mine is on the Southern Railway about 3½ miles north of Rutherfordton. A pegmatite formation over 30 yards thick has been found to carry mica in certain parts. The country

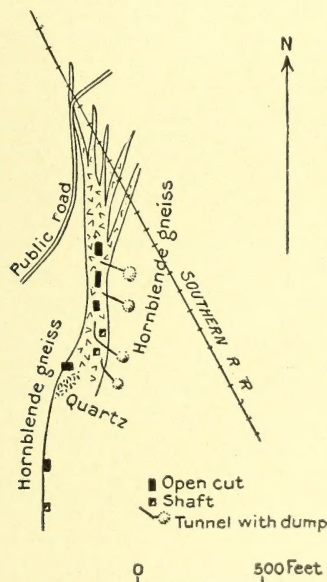


FIGURE 23 —Plan of workings and probable shape of the pegmatite in Isinglass Hill mine, Rutherford County, N. C.

rock is hornblende gneiss, badly folded and contorted, and the pegmatite is roughly conformable with it. The strike is east of north and the dip in general nearly vertical. The pegmatite near the mica workings is many yards thick and in a railroad cut 200 yards to the north shows only as small streaks,

probably stringers from the main mass after it had forked into smaller branches. The pegmatite has been traced over 200 yards to the south by prospect shafts, but it is not known how thick it is at these points. Mica was found most plentifully in the portion where the open cuts are shown in figure 23. It is principally associated with a massive quartz streak in this place. The depth to which the mica workings were carried could not be ascertained because they had caved in badly, owing to the soft, decomposed nature of the rocks. The mica is in large part badly "specked" with magnetic iron. To judge from the large quantity of sheets 2 to 5 inches in diameter left on the dump, mica must have been very plentiful where found. Much of this waste mica was either "A" or "wedge," however.

Since the operations for mica were suspended the deposit has been examined for its value as a kaolin mine, and for this purpose some of the tunnels on the east and shafts to the south were made. Good kaolin was found in some of the openings, but its extent had not been adequately proved at the time of visit. The following analysis of the kaolin, made by T. W. Smith, commercial chemist, Indianapolis, Ind., was furnished by Mr. Oliver, owner of the mine:

*Analysis of Kaolin from Isinglass Hill Mine, N. C.*

SiO <sub>2</sub> .....	44.12
Al <sub>2</sub> O <sub>3</sub> .....	39.50
CaO .....	.08
MgO .....	Trace
FeO .....	.08
Alkalies .....	.81
Ignition .....	14.53

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99.12

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*Rational analysis:*

Clay substance .....	95.59
Quartz .....	3.39
Feldspar .....	1.02

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100.00

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WILKES COUNTY.

*Joel Triplett Mine.*—The Triplett mica mine is near Hendricks on Stony Fork, 16 miles from Wilkesboro. There are three mica prospects on this property, one of which was opened several years ago by a tunnel 40 feet long. A pegmatite about 8 feet thick had been exposed approximately conformable with the mica gneiss country rock. The latter had a strike of N. 30° E. and a dip of 35° SE. and contained numerous small lenses and masses of quartz and pegmatite throughout. Mica was segregated in various small-sized blocks along the walls of the pegmatite. Some 50 pounds of sheeted and cut mica were seen. The sheets ranged in size from 2 by 2 to 4 by 4 inches. In quality the mica varied from clear sheets with good cleavage to smoky or "specked" and "A" mica. The color of the best was rather dark greenish brown in sheets a sixteenth of an inch thick or more.

CLEVELAND COUNTY.

*M. M. Mauney Mine.*—The Mauney mica mine is about 1 mile southwest of the old Camp Call post-office, or 9 miles northwest of Shelby. It was first worked over thirty-five years ago and has not been worked within twenty years. The country rock is much crumpled mica schist-gneiss with a general strike of about N. 45° W. The pegmatite cuts across this with a strike of N. 20° E. and a nearly vertical dip. The part exposed in the old workings is composed of a quartz bank about 5 feet thick with 2 to 4 feet of feldspar, quartz, and mica on both sides. The mine was worked by an



open cut 20 feet deep and 40 feet long, and a shaft with tunnels, both now fallen in. The mica streak was all removed on the west side of the quartz ledge in the bottom of the open cut and only partly so on the east side. The mica is of fine quality, with a clear "rum" color. Specimen sheets measuring a foot across have been kept in the Mauney home.

*S. J. Green Mine.*—The Green mine is about 7 miles northwest of Shelby. The mine was opened in the seventies and operated again at later dates. The workings have fallen in badly and but few notes were obtained. The country rock is mica schist-gneiss striking north with a dip of 70° W. The vein strikes about N. 70° E., as shown by the position of eight or ten shafts and pits with tunnels. These workings are all within a distance of about 60 yards of one another. Streaks of massive quartz up to 3 feet thick were encountered in the pegmatite in the workings. In one of the workings the material was obtained from the north wall of one of the quartz ledges. The pegmatite is rich in feldspar, more or less kaolinized in places. The mica is of good quality and has a clear "rum" color.

*Indian Town and Casar Mines.*—The Indian Town and Casar mines are in the north end of Cleveland County, 3 miles north of east of Casar and on the southeast side of Casar, respectively. There is so much similarity in the occurrence in each group of mines and so little to see of the formation at any one of the separate mines that a general description will answer for all. The Indian Town mines cover an area of over a square mile and consist of a dozen or so small open cuts or shallow shafts which have caved in badly. The same may be said of the deposits near Casar and of one near Carpenter Knob, 5 miles east of Casar. The country rock of this general region is a highly schistose gneiss with mica, cyanite, and garnet as constituent minerals. The gneiss has been much folded and crumpled over the whole region and has been intruded by granite masses in places. The pegmatite bodies, opened for mica, appear to cut across the schistosity of the gneiss as a general rule, though in some places they lie conformable with it. They range in thickness from 2 to 15 feet and are rather irregular in shape. In most of the deposits masses of quartz are encountered, generally in the form of ledges or veins within the pegmatite. The occurrence of large bodies of feldspar or its alteration product, kaolin, with the mica is not common. Much of the mica obtained in this region is of excellent quality and has a rich "rum" color. Part has "A" markings, but large sheets have been cut between the "A" lines.

#### LINCOLN COUNTY.

*Thomas Baxter Mine.*—The Baxter mica mine is about three-fourths of a mile from the southwest corner of Lincoln County, on the old Rutherford-ton road. It is probably the oldest mine in the county and is reported to have been opened before 1870. The workings have nearly all fallen in, and little could be determined of the formation. There were six to eight shafts and cuts with tunnels. One shaft is said to have been 65 feet deep, with good mica in the bottom. The ground-water level in a well near the mine was about 35 feet below the surface. The workings fall within an area about 50 yards wide and 75 yards long in a direction north of east. The country rock is much-folded mica schist-gneiss. A large quartz vein or ledge outcrops in a direction N. 70° E. through the workings. The mica is of the best quality, splitting well, and has a beautiful clear "rum" color. Large quantities of weathered small sheet mica 1 to 2 or 3 inches in diameter are scattered around the mine. It is said that the mine was a large producer, including many pounds of large sheets, as 8 by 10 and 10 by 12 inches.

*M. M. Hull Mine.*—The Hull mine is about 2½ miles northeast of Hull's Crossroads. This mine, which was opened about 1891, is sometimes called the Rock Cut mine. The work consists of a cut 40 feet long, 20 feet deep, and 5 feet wide. The pegmatite strikes N. 70° E. and is nearly vertical. It

cuts across the cyanitic mica gneiss country rock, which strikes N. 10° E. and dips 50° SE. Bunches of small mica are still left in the walls. The color and quality of the mica are of the best, and some sheets 10 by 14 inches are reported to have been found.

*John Dillinger Mines.*—The Dillinger mines, of which No. 1 is 2 miles south of Henry on the roadside and No. 2 is on a branch one-fourth mile west of the same road, were worked in 1905 and 1906 by the Cawood Mica Company. At each mine the country rock is much folded cyanitic mica gneiss. The pegmatite streak in each is irregular and has an east-west strike. Each mine was opened by a cut from 18 to 20 feet deep. In the No. 1 mine much of the mica found was "A," but of good color and with some clear portions. In the No. 2 mine the pegmatite had quartz ledges in it and the most mica was found alongside of these. Beryl was also reported as found in this mine.

#### STOKES COUNTY.

*Joe Hawkins Mine.*—The Hawkins mica mine was first opened about 1890 by people living in the county and during 1903 was again operated by the Empire Mica Company, of New York. It is about 2½ miles southwest of Sandy Ridge, in the northeastern part of Stokes County. The mica occurs in an irregular massive pegmatite formation, in which feldspar and quartz form large separate masses. The pegmatite varies from 6 to 12 feet in thickness, as exposed in the workings, and is approximately conformable to the inclosing mica gneiss country rock. The latter strikes a little north of east and dips about 35° N. Much of the quartz of the pegmatite occurs in bands or sheets, from a few inches to about 2 feet in thickness, lying parallel with the strike of the pegmatite. But little mica had been left in the "vein" from the last work, and much of that seen was of the "wedge" and "A" nature, with good portions between the "A" structure lines. Some of this wedge and distorted mica included rough garnets, either in crystals or flattened between the laminae. The workings consist of two open cuts, with an incline on the pegmatite from one, and three shafts 20 to 30 feet deep with tunnels connecting them. In all there are nearly 150 feet of tunnels and incline. Figure 24 gives a general plan of the workings.

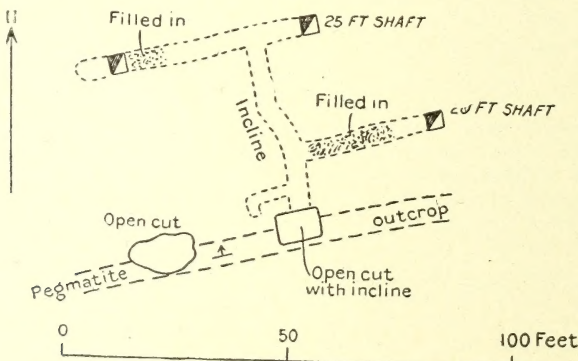


FIGURE 24.—Plan of Joe Hawkins mine, Stokes County, N. C.

*Hole Mine.*—The Hole mica mine is on the ridge between Dan River and Big Creek, near the mouth of the latter, and near Tulip postoffice. There are two separate mica-bearing pegmatites at this mine, opened at points about a third of a mile apart in an east-west direction. The principal deposit consists of a large pegmatite over 20 feet thick, striking nearly east and west with a dip of 30° N. As exposed in the open work on the outcrop



and small inclines, the pegmatite is composed of three bands or veins of massive quartz from 4 to 6 feet thick, with two beds of feldspar 4 to 7 feet thick between them. It is said that another feldspar band was developed beneath the lower quartz vein exposed at the time of visit, but this was covered with rubbish and could not be examined. The quartz and feldspar bands or veins are parallel and dip with the pegmatite to the north. The feldspar has kaolinized to a large extent and has been removed from the two veins exposed in inclines 10 and 20 feet deep. There were smaller masses and streaks of quartz 1 to 10 inches thick in the large feldspar streaks. Figure 25 is an ideal cross section of the pegmatite. The pegmatite can be traced a number of yards along the outcrop by massive white quartz boulders. Mica occurs through the feldspar masses and along the

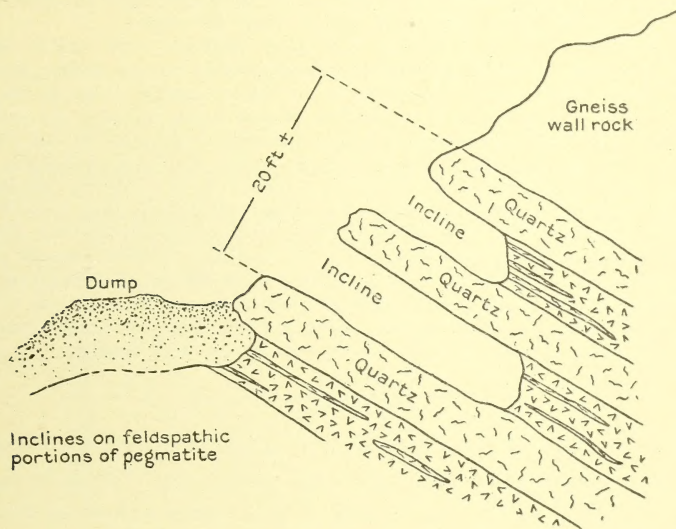


FIGURE 25.—Ideal cross section at Hole mine, Stokes County, N. C.

contact with the quartz streaks. The mica is partly of the "A" variety, and a 20-pound block of such mica was seen in the face of one of the veins. The mica has a brownish or smoky color.

At the other outcrop a few small open cuts and an incline 20 feet deep have proved the pegmatite for about 200 feet along a steep hillside. The pegmatite here is conformable with the mica gneiss country rock and is several feet thick. The dip and strike are very much the same as at the deposit first described. The feldspar of the pegmatite has not been kaolinized, however, and the formation is fairly hard. Only small mica blocks were seen in the hard rock, and this mica was of clear dark-green color, considerably ruled.

#### ORIGIN.

Mica of commercial size in North Carolina occurs only in pegmatite. There has been considerable difference of opinion concerning the origin of this rock in different regions, some writers arguing for intrusion as an igneous magma, others for deposition from solution. One group maintains that pegmatite formed as dikes, the other that it formed as veins. Still other authors consider pegmatite to be the product of aqueo-igneous processes in which there are all gradations between the conditions of a magma and those of a solution. Accordingly, it would be impossible to draw a sharp

line between pegmatites formed as dikes and those formed as veins. In some places the nature of the pegmatite and its relation to the accompanying rock are such that it may be stated with a fair degree of certainty to which class the deposit belongs.

In the mica-bearing pegmatites of North Carolina there are features that may be interpreted as showing an intrusive origin in one place and a solution deposit in another place. On the other hand, a large number of the deposits possess features characteristic of both dikes and veins, so that it is not possible to assign one method of formation or the other. It is probable that the greater number of the pegmatites opened for mica in North Carolina approach conditions of vein formation more closely than they do those of dike formation. This is in contrast with the mica bearing pegmatites of South Dakota,\* which, in the greater number of places, are thought to possess features characteristic of dikes rather than of veins.

Features observed in pegmatites that may indicate vein origin are the presence of quartz veins or sheets oriented parallel to the walls; the similarity of these quartz veins or sheets to ordinary quartz veins in the mica region; horses of wall rock in sheetlike bodies lying parallel to the walls (by intrusion such sheets would tend to be turned or bent at an angle to the walls); the occurrence of pegmatite in small lens-shaped bodies; balls, veinlets, and other replacement deposits, some of them entirely disconnected with other pegmatite masses. The following conditions are possible evidence of intrusion: The occurrence of irregular-shaped horses and distorted sheetlike horses without parallelism to the walls; a typical coarse granite texture and its persistence through a considerable distance; a bending of the schistosity of the inclosing rock around pegmatite bodies without evidence of replacement (this may also take place around deposits from solution in which the force of crystal growth has distended the wall rock).

#### PRODUCTION.

The total values of the production of mica in North Carolina during the years 1908, 1909, and 1910 were as follows: For 1908 the production amounted to 599,234 pounds of sheet mica valued at \$114,540, and 1,308 short tons of scrap mica valued at \$13,330, giving a total value for that year of \$127,870; for 1909 the production consisted of 1,296,274 pounds of sheet mica valued at \$122,246, and 2,607 short tons of scrap mica valued at \$26,178, the total value being \$148,424; the production for 1910 amounted to 455,020 pounds of sheet mica valued at \$193,223, and 3,074 short tons of scrap mica valued at \$37,237, making a total value of \$230,460. An analysis of the above figures will show that while the value for the 1908 production was low as compared to previous years, shown in the table following, the value has steadily come up and in 1910 was greater than any previous year recorded. There is given in the following table the approximate value and distribution of the production of mica (both sheet and scrap) by counties for the years 1906 to 1910, inclusive.

\*Mica deposits of South Dakota: Bull. U. S. Geol. Survey No. 380, 1909, pp. 382-397.



PRODUCTION OF MICA IN NORTH CAROLINA DURING 1903-1910,  
BY COUNTIES.

County	1905	1907	1908	1909	1910
Ashe.....	\$ 4,000	\$ 1,500	\$ 1,200	\$ 155	\$ 500
Buncombe.....			50		
Cleveland.....					3,040
Haywood.....	15,975	17,000	15,000		5,600
Jackson.....	20,899	31,625	22,600	4,852	12,726
Lincoln.....	210	300	0		0
McDowell.....	0	0	500	0	500
Macon.....	47,863	34,525	20,800	45,632	50,300
Madison.....					780
Mitchell.....	51,540	76,846	35,620	59,710	93,890
Stokes.....	731				200
Transylvania.....	11,275	3,500	2,100	5,415	6,140
Watauga.....	916	30			
Yancey.....	64,284	59,880	30,000	32,660	56,784
Totals.....	\$ 217,696	\$ 225,205	\$ 127,870	\$ 148,424	\$ 230,460

The next table gives the value of the total production of mica, including both sheet and scrap, for the years 1900 to 1910, inclusive.

PRODUCTION OF MICA IN NORTH CAROLINA, 1900-1910.

Year	Sheet Value	Scrap Value	Total Value
1900.....	\$ 65,200	\$ 36,262	\$ 101,462
1901.....	79,849	14,200	94,049
1902.....	81,653	2,219	83,872
1903.....	86,300	2,400	88,700
1904.....	100,724	3,410	104,134
1905.....	100,900	3,375	104,275
1906.....	205,756	11,940	217,696
1907.....	209,955	15,250	225,205
1908.....	114,540	13,330	127,870
1909.....	122,246	26,178	148,424
1910.....	193,223	37,237	230,460

In order to show the ratio of the production of mica in North Carolina to the total production in the United States and the value of the imports, there is given in the next table figures covering these points for the years 1903 to 1910, inclusive.

PRODUCTION OF MICA IN THE UNITED STATES AND IN  
NORTH CAROLINA AND THAT IMPORTED INTO THE  
UNITED STATES FROM 1903-1910.

Year	Production in N. C.	Production in U. S.	Import
	Value	Value	Value
1903.....	\$ 88,700	\$ 143,128	\$ 317,969
1904.....	104,134	120,316	263,714
1905.....	104,275	178,588	403,756
1906.....	217,696	274,990	1,042,603
1907.....	225,205	392,111	952,259
1908.....	127,870	267,925	266,058
1909.....	148,424	280,529	618,813
1910.....	230,460	337,037	724,525

The average prices of sheet mica in the United States during the years 1908, 1909, and 1910, respectively, were 24.1 cents per pound in 1908; 12.9 cents per pound in 1909, and 11.5 cents per pound during 1910. The average price of sheet mica per pound in North Carolina during 1908 was 19.1 cents; during 1909 it was 9.4 cents, and during 1910 it was 42.5 cents, the price varying according to the size and quality of the sheets placed on the market. The average price per ton of scrap mica in North Carolina during 1908 was \$14.02; during 1909 it was \$11.26, and during 1910 was \$13.10.

### QUARTZ (FLINT).

No quartz has been produced in North Carolina since the year 1907. The principal use that has been made of the North Carolina quartz has been as a flux in copper smelting, and practically all that has been mined was obtained from Cherokee County and used in the copper smelters at Ducktown, Tennessee.

Investigations have been made of the kaolin deposits of the western part of this State with a view to the possibility of their use for pottery or porcelain industries; and, if such an investigation should result in the establishment of any large plants in this State, there will be a considerable demand for a quantity of the quartz that occurs in Piedmont and Western North Carolina. In the table below there is given the production of quartz in North Carolina since the year 1901.

PRODUCTION OF QUARTZ IN NORTH  
CAROLINA, 1901-1910.

Year	Quantity	Value
	<i>Tons</i>	
1901.....	3,000	\$ 7,500
1902.....	4,500	11,250
1903.....	29,462	36,827
1904.....	32,972	36,269
1905.....	32,648	13,659
1906.....	20,963	12,578
1907.....	4,226	1,664
1908.....	-----	<i>a</i>
1909.....	-----	<i>a</i>
1910.....	-----	<i>a</i>

*a* Small quantity of quartz.

### BARYTES.

Barite, or barytes, as it is known commonly, a sulphate of barium ( $\text{BaSO}_4$ ) is a heavy white crystalline mineral with a perfect prismatic cleavage and is found rather widely distributed in nature. It does not usually occur in well-defined veins, but is more often found in a series of pockets or lenses of varying dimensions. These are more or less in line, often filling the dip of the rock with which they are associated,



which in most cases is limestone. In some instances the rock is entirely decomposed and the pockets of barytes occur in clay. A mineral commonly associated with barytes is galena, a lead sulphide. On account of the alteration of the rocks with which the barytes is associated, it is usually more or less iron stained so that it is often necessary for the barytes to be ground, washed, and bleached with acids in order to purify it. Some, however, is found of sufficient purity so that it does not need any washing or bleaching whatever.

The uses for barytes are somewhat varied, but by far the greater part of this mineral produced is used in the manufacture of mixed paints, in the ground, or ground, floated, and bleached condition. It has a permanently pure white color, unaffected by the weather or by causes which in most cases will blacken white lead; but on account of its crystalline nature it is too transparent to be used alone as a white pigment. It is used, however, in mixed paints with either white lead or zinc white, or a combination of both. One very white pigment, which is composed partly of barytes, is lithopone, which is especially adapted for interior use in enamel and wall finishes. *Blanc fixe* is a precipitated form of barium sulphate which is used as a base on which lake colors are precipitated. It is also employed in the manufacture of wall paper, rubber, and in tanning leather.

The principal barytes deposits of North Carolina are in Madison County in the vicinity of Marshall, Stackhouse, Sandy Bottom, and Hot Springs; and in Gaston County, about 5 miles from Bessemer City. North Carolina barytes is of good quality and occurs in considerable quantity, and any increase in price in the value of this mineral is of interest to this State. The Payne-Aldrich Tariff increased the duty on raw barytes 100 per cent, but made no change in the duty on the manufactured product. During 1909, the first year of the operation of the increased duty on raw or unmanufactured barytes, there was a small decrease in the importation as compared with 1908, but in 1910 the imports increased more than 91 per cent.

#### PRODUCTION.

The production of crude barytes in North Carolina for the past three years has been made by but one producer, and the figures, therefore, can not be given separately. In the following table there is given the production of barytes in North Carolina from 1901 to 1907, inclusive. The productions for 1908, 1909, and 1910 are given in the general mineral table, page 10, under "Miscellaneous."

PRODUCTION OF CRUDE BARYTES IN  
NORTH CAROLINA, 1901-1907.

Year	Quantity Short Tons	Value
1901-----	6,890	\$ 20,865
1902-----	14,679	44,130
1903-----	6,835	21,347
1904-----	13,413	33,930
1905-----	5,545	21,670
1906-----	3,340	10,020
1907-----	5,785	18,855

**MONAZITE.\***

The world's sources of supply of monazite for many years have been Brazil and the United States. The greater part of the monazite produced in the United States is used in this country, and, for a number of years, the supply has come principally from North Carolina, with smaller amounts from South Carolina. While the amount of monazite produced in North Carolina has for the last two years steadily decreased, due to the large amount imported at a lower price than it could be produced in this country, this is still one of the important minerals mined in the State. The demand for this mineral, because of its thorium content, is steadily increasing. Mr. Douglas B. Sterrett of the U. S. Geological Survey has made a brief report† on the monazite deposits of the Carolinas, which is given below:

**MONAZITE DEPOSITS OF THE CAROLINAS.**

BY DOUGLAS B. STERRETT.

Monazite has earned a prominent place in the commercial world through the rare-earth metal, thorium, which it carries as an accessory constituent. As a source of cerium and other rare-earth metals, also, monazite is of great interest to chemists. In composition it is essentially an anhydrous phosphate of cerium, praseodymium, neodymium and lanthanum in which thorium and silica are present in variable amounts. The amount of thorium in monazite ranges from less than 1 to 20 per cent or more, but its average amount in monazite obtained for commercial purposes varies between 3 and 9 per cent.

Though sometimes found in large crystals and masses of many pounds' weight, monazite for economic purposes is obtained in the form of sand, occurring in opaque to translucent and in some cases transparent grains and crystals. Monazite ranges in color mainly from light yellow to reddish yellow and brown; some of it is greenish. The freshly broken and unaltered mineral has a resinous to adamantine luster, which is especially marked on the cleavage faces. The mineral is brittle and has a hardness of 5 to 5.5. It can readily be crushed between the teeth and yields a soft grit, quite distinct from the harder minerals sometimes mistaken for it. The specific gravity ranges from 4.9 to 5.3 and is generally over 5.

The principal use made of the thorium extracted from monazite is in the manufacture of incandescent mantles for gas lighting. These mantles are made by immersing sections of a cotton gauze or netting, woven in tubular form, in a saturated solution of the salts of certain rare earths. The composition of this mixture of salts used by different manufacturers is kept

\*See also the following reports of the North Carolina Geological Survey: Bulletin No. 9; Economic Papers No. 6, pp. 53-61; No. 8, pp. 34-40; No. 9, pp. 40-45; No. 11, pp. 37-42; No. 14, pp. 103-123; and No. 15, pp. 61-66.

†U. S. Geological Survey, Bulletin 340, Part I, pp. 272-285.



secret, but it is said to contain thorium largely in excess of the other constituents. The sections of the tubes are then dried after one end has been drawn into the form of a mantle by a platinum wire. When dry, the organic matter of the cotton is burned off and the mantle is saturated with some form of wax, which holds it in shape during shipment and is readily burned off when it is set up for use.

The production of monazite in the United States for commercial purposes has, up to the present time, come entirely from North and South Carolina. The occurrence of the mineral and the development of the industry in these States have been described in reports by Henry B. C. Nitze,\* Joseph Hyde Pratt,\*\* L. C. Graton\*\*\* and the writer.†

The value of the production of monazite from the Carolinas is small compared with that of the more important minerals produced in the United States. The benefit to the region in which the monazite is mined, however, has been considerable.

The present paper is intended to furnish general information on monazite, including a description of the deposits in the Carolinas and of the occurrence of the minerals in them, with a discussion of their bearing on its origin. The data used were obtained during brief visits to different parts of the region.

Acknowledgment is here made for the courtesy and general information received from the various operators in the monazite field. Among these are Mr. George L. English, of the National Light and Thorium Company; Mr. W. F. Smith and Mr. M. E. Gettys, of the Carolinas Monazite Company; Mr. Hugh Stewart, formerly of the British Monazite Company; and Mr. Herman Wanke, of the German Monazite Company. Further acknowledgment is made to Mr. A. Keith for valuable criticism.

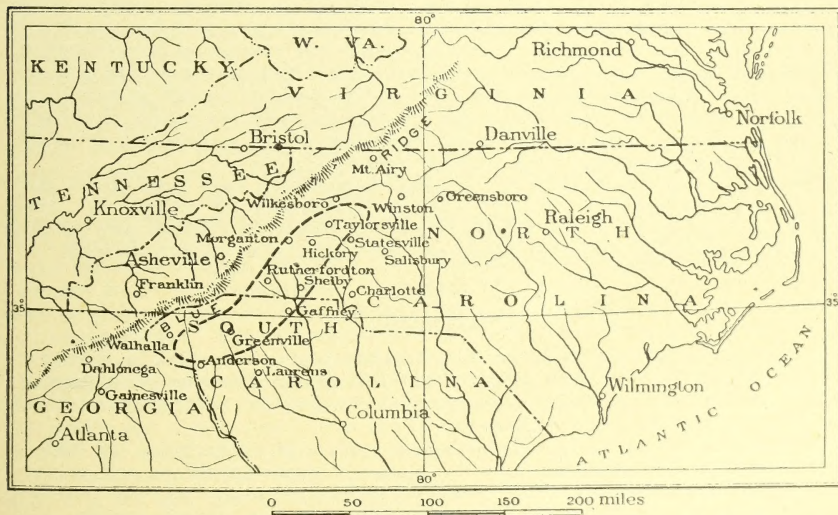


FIGURE 26.—Map showing area of monazite deposits of known commercial value in southern Appalachian region.

#### GEOGRAPHY.

Geographically, the area in which deposits of monazite of commercial value have been found lies in the central portion of Western North Carolina and

\*Monazite and monazite deposits in North Carolina; Bull. North Carolina Geol. Survey, No. 9, 1895.

\*\*Monazite: Mineral Resources U. S. for 1901 to 1905, U. S. Geol. Survey, 1902 to 1906. Also Mining Industry in North Carolina, an annual publication of North Carolina Geol. Survey, 1901, 1903, 1904 and 1905.

\*\*\*Gold and Tin deposits of the Southern Appalachians; Bull. U. S. Geol. Survey No. 293, 1903, pp. 116-118.

†Monazite: Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1907.

in the extreme northwestern part of South Carolina. Fig. 26 shows the area containing monazite deposits of known commercial value. This area covers about 3,500 square miles and includes part or all of Alexander, Iredell, Caldwell, Catawba, Burke, McDowell, Gaston, Lincoln, Cleveland, Ruth-erford, and Polk counties in North Carolina, and Cherokee, Laurens, Spar-tanburg, Greenville, Pickens, Anderson, and Oconee counties in South Caro-lina. The larger towns within or near the monazite region are Statesville, Hickory, and Shelby in North Carolina, and Gaffney, Spartanburg, and Greenville in South Carolina. The appearance of Alexander County, N. C., in the list of counties with valuable monazite deposits is the result of pros-pecting by mining companies during 1907.

#### PHYSIOGRAPHY.

Physiographically, North and South Carolina are divided into three parts. These are the Coastal Plain, extending from the Atlantic Ocean northwestward for 100 to 150 miles; the Piedmont Plateau, extending from the limits of the Coastal Plain northwestward for 100 to 130 miles to the foot of the Blue Ridge; and the mountain region, extending northwestward from the Piedmont Plateau to the State lines. The Coastal Plain and the Pied-mont Plateau are prominent in both States, but only North Carolina contains a large portion of the mountain area.

The Coastal plain is a broad, nearly flat stretch of country rising from sea level on the southeast to an elevation of a few hundred feet on the northwest, in which direction it is practically limited by the boundaries of the rock formations of which it is composed. The Piedmont Plateau is an elevated district rising from a few hundred feet above sea level on the southeast to 1,200 or 1,500 feet on the northwest. It forms a plateau much dissected by valleys from 50 to 200 or 300 feet deep, and its regularity is further disturbed by scattered mountain peaks and smaller hills rising above its general level. The features of the plateau are best observed from a prom-inent ridge or one of the smaller hills of the region. In the mountain re-gion are included the Blue Ridge and its foothills, and the higher mountains to the northwest. The country in the mountain region is exceedingly rough, and the elevations range from 1,500 to over 6,500 feet.

The region in which valuable deposits of monazite have been found may be defined as a belt from 20 to 30 miles wide and over 150 miles long. (See fig. 26, p. 73.) This belt lies wholly within the Piedmont Plateau, and borders closely on the Blue Ridge, to whose general course it is roughly parallel.

#### GEOLOGY.

##### *Formations.*

The most important rocks of the monazite belt are gneisses and schists. These include the Carolina gneiss, the Roan gneiss, and gneissoid, porphy-ritic, and massive granites. Other rocks are pegmatite, peridotite and allied rocks, quartz diorite, and diabase.\*

The oldest formation in the monazite region is of Archean age and is called the Carolina gneiss. It is the most extensive formation and appears in nearly every section. The composition and structure of the Carolina gneiss are varied. The most common types are mica, garnet, cyanite, and graphite gneisses and schists, or combinations of two or more of these types. These rocks range in color from light gray to dark gray, and in many places where graphite is abundant in them have a light bluish-gray to bluish-black cast. Some of the gneisses and schists are fine grained and are composed of several distinguishing minerals, as biotite, muscovite, cyanite in fine needles, and graphite, besides fine grains of quartz and other minerals; other rocks are composed of the same minerals in coarser grains or flakes. Gar-net appears in both fine and coarse grained gneisses and schists and may be

\*The formation names used in the description of these rocks are taken from Keith, A., *Geologic Atlas U. S.*, folios 116 (Asheville), 124 (Mount Mitchell) and 147 (Pisgah) and others.



fairly large, even in the rocks of finer grain. The presence of much pegmatitic material is a characteristic feature of the Carolina gneiss.

The Roan gneiss is the next oldest formation in the region and is also of Archean age. It consists of hornblende gneiss and schist, with here and there the less metamorphosed phase, diorite. The hornblende gneiss and schist are nearly black to dark green in color, and are composed chiefly of small interwoven and matted hornblende crystals. These hornblendic rocks grade into diorite, which is also dark colored but contains a noticeable amount of feldspar and has a granitoid texture. Bands of mica gneiss or schist are included in many both large and small masses of Roan gneiss. This formation is prominent along the northwest side of the monazite belt, throughout its length. In the central and more eastern portions, however, it is of less importance and in many places does not appear at all.

The age of many of the granites and granite gneisses has not been determined, though a part are probably Archean. In importance, granite and its different phases are second and are particularly prominent in many localities where extensive monazite deposits have been found. In composition the granite may be biotitic, muscovitic, or hornblendic; its texture may be porphyritic, massive, gneissic, or schistose. Where both porphyritic and schistose the feldspar phenocrysts generally assume an augen form, caused by crushing and elongation in the direction of shearing. Some large masses of granite gneiss have an abundant development of small red garnets. The occurrence of much quartz in veins and veinlets throughout the mass is a characteristic feature of most of the granites of this region. Some of this quartz is simply massive; at other places it has a more or less well-defined crystal form. Drusy surfaces are not uncommon on such crystals. The abundance of quartz veins is not invariably confined to the granite masses, but in numerous places extends some distance from the contact of the granite into adjacent formations.

Pegmatite is a common rock throughout the monazite region, especially in those areas where commercial deposits of monazite are found. Two principal occurrences of pegmatite are here recognized. In one it forms distinct masses or bodies with the typical composition and texture—that is, it is composed of quartz and feldspar, with or without mica and other accessory minerals, crystallized out on a large scale. The other type is a pegmatized gneiss, representing the addition of the pegmatite minerals to the gneiss, with perhaps some re-crystallization of portions of the inclosing rocks. In some places secondary quartz is the principal mineral added, while feldspar appears in smaller quantities. In others the feldspar is more prominent, and is prone to assume a porphyritic form in the gneiss, producing a typical augen gneiss. Very commonly the gneisses and schists are banded with or cut at all angles by streaks of pegmatitic or granitic material. The re-crystallization of the gneisses and schists, with the development of pegmatitic material or the injection of such material into the rocks, may be called pegmatization. In many places the process has gone so far that it is very difficult to distinguish pegmatized rock from granite gneiss and especially from flow-banded and porphyritic granite gneiss. This difficulty is due partly to the fact that granite and pegmatite are composed of the same minerals and have no sharp division line between the size of their grains.

The peridotites are dark-green to greenish-black basic rocks, containing one or more of the ferromagnesian minerals olivine, pyroxene, and in places hornblende as chief constituents. So far as known the peridotites of this region are of Archean age and are apparently genetically connected with the Roan gneiss. Though composing but a very small part of the rocks of the monazite belt, the peridotites generally outcrop prominently wherever they occur, and many outcrops are marked by large rounded "nigger-head" boulders scattered over the surface. For the most part the peridotites have altered to talcose or chloritic soapstone or to serpentine. This alteration is, in some places, only superficial, but in others whole masses have been so



metamorphosed. The usual form of occurrence of the peridotites is in lens-shaped bodies parallel, or nearly so, to the schistosity of the inclosing rocks.

Quartz diorite of undetermined age is one of the less important intrusive rocks in the monazite region. It is a fine-textured rock, composed of granular quartz and feldspar with more or less hornblende, locally with garnet distributed promiscuously through it. The occurrence of quartz diorite is generally in small dikes ranging from a few inches up to several feet in thickness. The diminutive size of these dikes, however, is offset by their abundance and resistance to erosion, owing to which they leave much debris over many of their outcrops in the form of hard rounded boulders.

Diabase is the latest intrusive rock known in the region and is probably of Triassic age. It is a dense, hard rock of dark-green to black color, composed chiefly of olivine and a feldspar rich in lime. It is rather abundant in places and the outcrop is generally marked by characteristic spheroidal "nigger-head" boulders scattered over the surface. The diabase dikes range from a few inches up to 100 feet or so in thickness.

#### *Structure.*

The regional metamorphism, with accompanying folding and faulting of the rocks in this area has been extreme. In many places, especially in the Carolina gneiss, it is very difficult to determine the original nature of the formations, for much of the sedimentary structure or igneous texture of the rocks has been destroyed by mashing and recrystallization. The Carolina gneiss has been intruded by rocks of later age and cut by them into irregular-shaped masses, many of which fork out into long tongues or occur as narrow streaks in the intrusives, or vice versa. There have been successful intrusions of igneous rocks of later age into the earlier formations. Thus the Carolina gneiss is cut by the Roan gneiss, and both are cut by granites of later age. Many of the granites have included blocks of the formation in which they have been intruded. In places the inclusion has been more or less absorbed by the surrounding granite, the composition of which has thereby been affected. Thus, where masses of hornblende gneiss are included in granite, the latter is generally highly hornblendic in their vicinity.

The structure of the pegmatite in the rocks of this region is extremely irregular. In some places the pegmatite occurs in the form of sheets or lenses interbedded and folded with the inclosing gneisses and schists. In other places it occurs in dikes, veins, or lenses either conformable with the inclosing rocks through part of its extent and cutting across them in other parts, or in irregular masses having no definite orientation with respect to the accompanying formations. In pegmatized rock masses the pegmatization has generally affected certain beds, which may grade into regular pegmatite in either the direction of their greatest or that of their least extension. In such rocks it is often impossible to determine the line of demarcation between the two. There is also a gradation between the pegmatized beds and ordinary gneiss.

Quartz diorite almost invariably occurs in small dikes, in places conformable with the schistosity of the country rock, though elsewhere cutting across it at all angles. The diabase dikes commonly cut across the strike and dip of all the older formations, filling a series of fissures which have a general northwest to north strike.

#### *Weathering and Soils.*

The rocks of the Piedmont Plateau have undergone such extensive weathering that good outcrops are the exception, and a thick mantle of residual soil covers much of the country. The variety of rock underlying certain soils can in many places be determined, unless decomposition has been too thorough, by studying the outcrops and graduations from such exposures into the residual soil.

The Carolina gneiss, on partial disintegration and decomposition, commonly forms a gravelly soil with a red clayey matrix. This is especially



characteristic of the garnetiferous and graphite-cyanite types, which are abundant in parts of the monazite region. The pebbles are composed of small fragments of the original rock, such as tufts of cyanite impregnated with hematite or limonite, iron-stained garnets, or pieces of hematite. On more complete decomposition a fine reddish clayey soil results, with no decided characteristics. Other types of the Carolina gneiss, in which mica is an important constituent, leave a micaceous soil, much of which assumes a purplish color. Granite and its various phases, on partial disintegration and decomposition, yield light sandy soils. On more complete decomposition the granites yield soils of a light to dark reddish color, depending on the quantity of ferromagnesian minerals, as biotite or hornblende, in the original rock. The quartz grains of the granite remain as sand mixed through a clayey matrix. This quartz sand is almost everywhere to be seen at the immediate surface, from which the clays have been washed by rains. Where Carolina gneiss and granite are intimately associated, or where pegmatization has been extensive in a body of Carolina gneiss, there results a sandy soil, characteristic of granite, through which are scattered pebbles of hematite and ferruginous cyanite, characteristic of the Carolina gneiss. The relative importance of pebbles in such soils decreases as the quantity of pegmatite or of granite in the rock formation increases. These features of the soils are especially marked on the broad, flat ridges characterizing much of the Piedmont Plateau region. The Roan gneiss leaves a greenish sandy soil on disintegration, and an ochre-yellow to dark reddish-brown or chocolate-colored clayey soil on decomposition. Black stains of manganese are associated with many of the soils derived from hornblendic rocks.

A clue to the nature of the rock formations in a given region is often furnished by the character of the gravels in the bottom lands and streams draining that region. Thus in this area a very light-colored gravel with much quartz debris indicates a granite or its contact or a very highly pegmatized country rock. Garnets and hematite iron ore, with which blocks of mica or cyanite gneiss are associated, indicate Carolina gneiss. Quantities of black sands in the stream gravels, containing magnetite, ilmenite, hornblende, etc., are characteristic of the Roan gneiss.

#### OCCURRENCE OF MONAZITE.

Up to the present time the only deposits of monazite successfully worked have been the gravel beds in streams and bottom lands, and in certain places surface soils adjoining rich gravel deposits. Prospecting and careful mill tests on monazite-bearing gneiss and schist have failed to discover deposits of a nature that could be worked extensively. The saprolite or rotted rock underlying some gravel deposits has been washed in small area, with results reported to be favorable.

#### *Placers.*

Commercial deposits of monazite in gravel occur in the beds of creeks and streams and the bottom lands along them. The thickness of the gravel ranges from a foot or two, including overburden, to 6 or 8 or more feet. The distribution of the monazite in them is, as with all heavy minerals, richer near the bed rock and poorer above, grading into the overburden. In some deposits the whole bed, with the finer alluvium at the surface, is rich enough to be washed directly or sluiced down and washed. The extent and value of these deposits vary with the topography of the country and the nature of the gravel. The best deposits are more commonly associated with light-colored gravels and sands, containing considerable quartz debris and fragments of other light-colored rocks, such as pegmatite, granite, mica, and cyanite gneiss. On the other hand, the absence of much quartz and pegmatitic or granitic debris from the gravels is generally characteristic of low-grade deposits of monazite. The presence of black sands—magnetite, ilmenite, hornblende, etc.—in the gravels does not necessarily indicate a low-grade deposit, unless quartz and pegmatitic minerals are lacking also.

*Residual Deposits.*

The surface soils on land adjoining some of the rich monazite deposits have been found to contain sufficient monazite to make sluicing down and concentrating profitable. This is the case to a depth of 3 or 4 inches or more in many residual soils that have suffered but little displacement on the surface, and to depths of several feet where the drift soil has collected on the gentle slopes below a steeper hillside. The partial concentration of monazite in the top layer of soil is caused by the washing away of the clay and other light decomposition products of the rock. The supply of monazite in the stream gravels in favorable areas is often replenished by the wash from the hillside soils during rains. This is especially true where the hills have any considerable slope and the land is cultivated. Under such conditions it is frequently profitable to work the stream gravels two or more times in a year.

The saprolite or rotted rock underlying the richer deposits of monazite is at some places sluiced down to depths of a few inches to a foot or so, along with the overlying gravels. At other places small amounts are removed and washed separately for the monazite they contain. The formations that have been found especially favorable for such work are highly pegmatized gneiss or schist. Such deposits have generally soon been lost or grown poor, probably on account of the fact that the miners have cut through the richer bed or failed to follow it in the direction of its extension. The occurrence of monazite in saprolite will be considered along with the occurrence of monazite in hard rock formations, as the former is merely an altered phase of the latter.

*Monazite in Rock Formations.*

Two separate companies have, at different times, undertaken to work a deposit of monazite-bearing rock about 3 miles northeast of Shelby, N. C. In each case the undertaking failed, because it was impossible to obtain sufficient ore of the high grade necessary to make the operations a success. At a number of the placer deposits ledges of rock have been found, either in the bed of the streams or near by, which contained monazite in noticeable quantity. So far the rock in which the monazite has been found in noticeable amounts is pegmatized gneiss.

It is possible in many of the mines to pan the saprolitic pegmatized gneiss under the monazite-bearing gravels almost at random and obtain monazite. The amount of the mineral obtained when the panning is done with a long-handled shovel ranges from a few grains to a teaspoonful per shovelful, according to the richness of the beds. Mr. George L. English has kindly furnished the results of a test made by him on the monazite content of the saprolite underlying the gravels at the F. K. McClurd mine, near Carpenter Knob, Cleveland County, N. C. From 30 cubic feet of saprolite 424 grams of concentrates, carrying about 40 per cent of monazite, were obtained by washing in a sluice box. This approximates closely one-third of a pound of pure monazite to a cubic yard of saprolite.

The monazite content of the rock at the deposit 3 miles northeast of Shelby, N. C., has been given a thorough test with a well-equipped mill by the British Monazite Company. The following data are given through the courtesy of Mr. Hugh Stewart, by whom the tests were made. Practically all the rock at the mine, through a vertical height of 15 to 18 feet across the bedding, carried monazite. The quantity in different beds ranged from 0.03 per cent and less up to 1.10 per cent and more. While the mill was in operation all beds carrying 0.4 to 0.5 per cent or more were treated as ore, while lower-grade material was discarded. According to Mr. Stewart, one ore bed with a thickness of about  $3\frac{1}{2}$  feet was found to average 1.10 per cent of monazite.

Most of the pegmatized gneiss bodies which are rich in monazite represent phases of the Carolina gneiss in which the original nature of the rock has been largely obliterated as a result of the addition of new minerals and the



recrystallization of the original ores into pegmatitic material. The texture developed during this pegmatization is generally porphyritic, in which the feldspar phenocrysts assume somewhat of an augen form. The feldspar phenocrysts range in size from those smaller than a grain of wheat to those the size of a walnut. The porphyritic gneiss may grade into less or more highly pegmatized gneiss, and from the latter into regular pegmatite. This gradation may be between two separate beds or from one part to another of the same bed. In those beds or portions of beds where there has been little pegmatization monazite occurs sparingly. The same is true where pegmatization has been complete and but little of the original gneiss remains. It is, then, the beds of gneissic rock which are rich in secondary quartz and contain numerous small masses of feldspar throughout that carry the most monazite. In such rocks there is generally much biotite, with graphite and perhaps some muscovite and other accessory minerals, as well as abundant quartz and feldspar. The quartz occurs in layers or scattered grains throughout the rock, inclosing and replacing the other constituents. The feldspar crystals chiefly replace, though they partly displace, the other minerals of the rock. Monazite in a rock matrix almost invariably possesses crystal form, in places having brilliant faces and sharp angles.

As a typical example of rich monazite-bearing rock, that from the British Monazite Company's mine, 3 miles northeast of Shelby, is chosen for de-

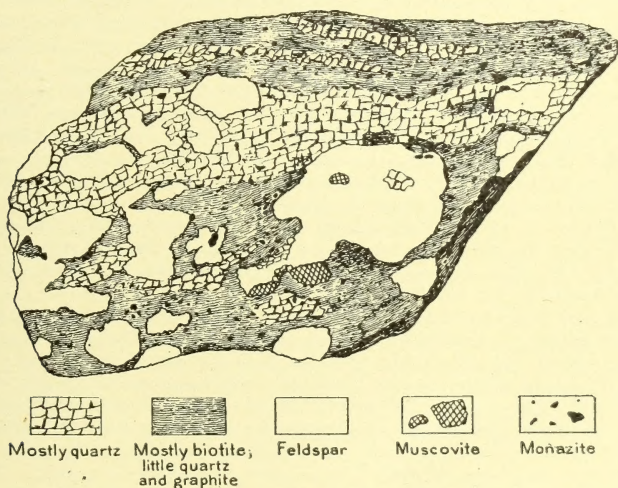


FIGURE 27.—Hand specimen of monazite-bearing rock from British Monazite Company's Mine, 3 miles northeast of Shelby, N. C. Three-fourths natural size.

scription. Fig. 27 represents a section across a hand specimen of this rock and shows the main feature to which attention will be called below. The chief constituents of this rock are quartz, feldspar (mostly the potash variety), biotite, graphite, muscovite, monazite, and a little zircon. It has a banded structure caused by the more or less separate occurrences of certain minerals arranged in parallel streaks, with a roughly parallel orientation of the crystals or grains of each mineral. The principal features of the banding as seen in the section consist of one large quartz streak with several smaller streaks and individual grains in a regular biotite schist. The other minerals of the section occupy various positions and show diverse relations to the minerals of these bands and to each other. The feldspar is porphyritic and occurs chiefly in individual crystals, some of which are of considerable size. A number of the feldspar phenocrysts are small bodies of pegmatite in themselves. As an example, the largest feldspar crystals

shown in the section includes both quartz and muscovite. The feldspar at the lower left-hand side of this crystal also has much quartz and muscovite associated with it. As shown in the section, the feldspar phenocrysts replace the other minerals. This replacement is especially well shown by the interruption, with but little displacement, of the lower biotite band by the large crystal described above. Graphite occurs in large amounts with biotite, though it is associated with nearly every other mineral of the rock. Where present, muscovite is chiefly associated with the feldspar. Monazite seems to be indiscriminately scattered through the rock, included in or associated with all the foregoing minerals. Though generally free from inclusions it is not invariably so, and in one case a plate of graphite was observed within a monazite crystal. All the minerals observed in the rock, with the exception of zircon, have been noted as inclusions in the feldspar phenocrysts.

In microscopic sections cut from specimens from one of the ore streaks, the minerals described above were observed, together with some iron staining. The feldspar is principally orthoclase and microcline, partially kaolinized. The quartz is plainly secondary, and occurs in bands or streaks of grains parallel with the schistosity of the rock. In some places the quartz has been deposited in the fractures or between the grains of other minerals; in others it replaces or includes fragments of such minerals as biotite and graphite.

Gas cavities and inclusions of very fine acicular needles, probably rutile, are abundant in the quartz. Biotite occurs in interwoven laths and crystals roughly parallel to the banding of the rock. The pleochroism of the biotite is light yellow-brown to greenish brown or dark purplish red. Graphite occurs as plates and laths, in general lying parallel to the banding of the rock. Some of it is interbanded and even interleaved with biotite; elsewhere the plates are turned across the foliation. In one section a lath of graphite was observed inclosed in quartz which filled a fracture across the foliation of a biotite crystal. Monazite occurs in contact with the various minerals of the sections, though it is more commonly surrounded by or included in grains of biotite and quartz. The position of the monazite in the biotite indicates replacement, and the biotite folia are not displaced around the crystals. In the microscopic sections sufficient feldspar was not observed to determine its relation to the other minerals.

The rock has been so thoroughly recrystallized that it is difficult to give the relative order of formation of the minerals. Biotite, if not still in its original condition, was probably the first mineral to form during recrystallization. Part of the graphite was probably contemporaneous with the biotite. Some, however, was introduced later and formed at the same time with the quartz. The small amount of muscovite in the rock was probably next to form, followed closely by quartz. From the small amount of feldspar in the microscopic sections, it was not possible to state its relative period of formation. From the hand specimen, however, shown in fig. 27, it is evident that the feldspar was introduced later than the quartz, or possibly contemporaneously with part of it.

#### ORIGIN OF MONAZITE.

Monazite has been observed in pegmatite, pegmatized gneisses and schists, and granite gneiss. The occurrence of monazite in pegmatite is that of an accessory original constituent, with the crystal form more or less well developed. But few occurrences in granites have been observed by the writer, and those were in highly gneissic porphyritic granite. The occurrence in pegmatized gneisses and schists indicates either a gathering together of the proper elements from the original rock and their formation into monazite during recrystallization, or the introduction of the proper elements from external sources, along with the materials causing pegmatization. It is probable that pegmatization in which much quartz with but little feldspar has formed represents a phase of recrystallization, in which the quartz may either, in part or wholly, have come from the original rock itself or may



have been added by solutions passing through the formations. In either case the materials do not represent the work of active magmatic solutions or magmas such as might give rise to regular pegmatite bodies. In those recrystallized or pegmatized rocks where the feldspathic component of pegmatite is not plentiful, monazite occurs but sparingly. On the other hand, monazite is found more abundantly in rock formations in which feldspar plays a prominent part. The common proximity of this form of pegmatization to granite masses gives evidence of its formation through magmatic agencies. Such pegmatized gneisses are probably the result of active magmatic solutions passing through the rock, both aiding in recrystallization of the original constituents, and depositing the materials held in solution when conditions of temperature or agents of precipitation were favorable. As evidence in favor of the association of monazite with the agencies that produce pegmatite may be cited the occurrence of large crystals of that mineral in the pegmatite worked for mica in Mitchell County, N. C.

The monazite of rock formations has, then, probably been derived from aqueo-igneous solutions such as give rise to certain forms of pegmatite and have in these cases affected large masses of rock.

#### SUMMARY.

The commercial value of monazite is due to the presence in the mineral of a small percentage of thorium. This element forms the basis for the manufacture of various forms of incandescent gas lights. The value of the production of monazite in the United States is small compared to that of other important minerals. Monazite deposits of commercial value have been found within an area of about 3,500 square miles, lying wholly in the Piedmont Plateau region of North and South Carolina. The principal rocks of this region are mica, garnet, cyanite, graphite, hornblende and granite gneisses and schists, massive granite, pegmatite, peridotite, quartz, diorite, and diabase. The structure of the rock formations is complex and in many localities metamorphism has been so extensive that the original nature of the rocks can not be determined. The rocks are in many places concealed by a heavy mantle of residual soil, but their character can often be learned by a study of these soils.

The only deposits of monazite that have been extensively and successfully worked are placers. These deposits are richest in regions where granitic rocks and pegmatized gneisses and schists abound. Residual surface soils and monazite-bearing saprolite are in some places sluiced down from small areas and concentrated. The best known occurrence of monazite in a rock matrix is in porphyritic pegmatized gneiss. In ordinary gneiss and in highly pegmatized gneiss, in which the pegmatite is so abundant that but little of the original rock remains, monazite occurs sparingly. In beds where pegmatization is prominent but not extreme monazite occurs more plentifully. Monazite in pegmatized gneiss is thought to be derived from aqueo-igneous solutions passing through the rock and depositing and recrystallizing portions of it into the minerals of pegmatite.

#### PRODUCTION.

The production of monazite in North Carolina during the years 1908, 1909, and 1910 amounted to 310,196 pounds, valued at \$37,224 in 1908; 391,068 pounds, valued at \$46,928 in 1909; and 83,454 pounds, valued at \$10,104 in 1910.

In 1910 the production of crude monazite sand in the United States amounted to 254,224 pounds, averaging about twenty-five per cent monazite. The crude concentrates yielded 99,304 pounds of refined

sand, whose value before cleaning was \$12,006. As will be seen from the above, nearly eighty-five per cent of the production of the United States came from North Carolina. The miners were paid a little more than twelve cents a pound for the refined monazite obtained from the crude sand delivered to the cleaning mills, or about three and one-half cents a pound for the crude monazite.

According to the U. S. Bureau of Statistics of the Department of Commerce and Labor, the imports of thorium nitrate for 1909 were but little less than twice as great as the imports for any one of the six preceding years, and the price per pound considerably less. The quantity of thorium nitrate imported in 1910 was the largest yet recorded and the value considerably less. From the above it can readily be seen the reason for the decrease in the domestic production of monazite—the large quantity of monazite and manufactured thorium salts imported steadily increasing and the price for the domestic production steadily decreasing. It is not thought likely that the monazite deposits of the Carolinas will be operated in more than a desultory way while the price of thorium nitrate is kept so low by foreign manufacturers. The present rate of duty (4 cents per pound) on monazite imported into the United States has opened a large market for foreign monazite. The imported monazite is valued at 8.7 cents per pound, but 4 cents duty raises it to 12.7. The price (12 cents per pound) paid to domestic miners for monazite does not include the expense of refining by electric magnetic machinery. In the table below there is given the production and value of monazite mined in North Carolina from 1893 to 1910, inclusive.

PRODUCTION OF MONAZITE IN NORTH  
CAROLINA, 1893-1910.

Year	Monazite	
	Pounds	Value
1893 .....	130,000	\$ 7,600
1894 .....	546,855	36,193
1895 .....	1,573,000	137,150
1896 .....	30,000	1,500
1897 .....	44,000	1,980
1898 .....	250,776	13,542
1899 .....	350,000	20,000
1900 .....	908,000	48,805
1901 .....	748,736	59,262
1902 .....	802,000	64,160
1903 .....	773,000	58,694
1904 .....	685,999	79,438
1905 .....	894,368	107,324
1906 .....	697,275	125,510
1907 .....	456,863	54,824
1908 .....	310,196	37,224
1909 .....	391,058	46,928
1910 .....	83,454	10,104



**ZIRCON.\*****PRODUCTION.**

The only year covered by this report in which a production of zircon was made was during the year 1909, when there was a production of about 2,000 pounds of zircon, valued at \$250, from the Jones mine near Zirconia, N. C., operated by Messrs. M. C. & C. F. Toms. In the following table there is given the production and value of zircon mined in North Carolina from 1902 to 1910, inclusive.

PRODUCTION OF ZIRCON IN NORTH  
CAROLINA, 1902-1910.

Year	Pounds	Value
1902-----	2,000	\$ 380
1903-----	3,000	570
1904-----	1,000	200
1905-----	8,000	1,600
1906-----	1,100	248
1907-----	204	46
1908-----		
1909-----	2,000	250
1910-----		

**TALC AND PYROPHYLLITE.†**

Although North Carolina contains many masses of soapstone, most of them are among the mountains with no transportation facilities, and, for this reason, the production of soapstone in the State assumes no commercial importance. On the other hand, however, North Carolina has always been a large producer of talc, the principal active mines in the State being those of the North Carolina Talc and Mining Company, at Hewitt, Swain County; the Alba Mineral Company, near Kinsey, Cherokee County; the American Talc Company, and the Glendon Mining and Manufacturing Company, at Glendon, Moore County.

*Talc.*—The mine at Hewitt is the largest of its kind in the State and has produced the best grade of commercial talc yet found in this country. In operating the lower portion of this deposit, the work has been greatly handicapped by water. One of the shafts, which had been out of commission for five years, has been reclaimed and operations resumed in it. Five years ago the miners struck a sand stratum in the roof of this shaft and it caved in, the shaft being flooded with the water of the Nantahala River. All efforts to reclaim the shaft proved fruitless until the plan was hit upon of filling the hole with timbers and covering it with cement. With this substantial roof, the matter of clearing out the water became easy. All other shafts on the property are protected by a natural roof of rock.

\*See Economic Paper No. 9, pp. 42-45.

†See also Economic Paper No. 3, of the N. C. Geol. Survey.

The Alba Mineral Company, which was more or less active during 1909, did not make any production during 1910, their operations having been interrupted by water. Their talc, however, is of a very promising quality, and, like that at Hewitt, occurs in connection with the Murphy limestone.

Another talc mine owned by the Hewitt Company is located in Graham County, 2 1-2 miles up the Yellow Branch of the Little Tennessee River, the nearest railroad station being Marens on the Tennessee Southern Railway, 9 miles below Bushnell. This property was worked some years ago, but only a small amount of talc was found. The country rock is biotite gneiss, with a large excess of quartz, and, embedded in it are seams of tremolite, much of which has been altered to talc. At the surface it is badly decomposed and little or no good talc was found. At a depth of about 40 feet good talc was encountered, however. It seems to occur in the form of a lens dipping or pitching to the southwest about 45 degrees, an opening from a narrow seam near the surface to a lens 30x40 feet at a depth of 60 feet. A vertical shaft is being sunk, which, at a depth of 65 feet, will be at the lowest level of the old working in the mines, which were opened by means of a shaft and also a tunnel that was started at the level of the brook.

Samples were obtained that had all the outward appearance of tremolite, but the material was pure talc. Masses of talc were found which contained, on breaking them open, small nodules of decomposed tremolite.

An unusual occurrence observed at this mine was crystals of beryl surrounded by the talc, and occasionally masses of galena as large as a man's fist. Garnet was also observed sparingly.

*Pyrophyllite.* The material mined near Glendon, though it resembles talc, is really pyrophyllite, a hydrous silicate of aluminum that has many of the physical properties of talc and may be used for the same purposes.

#### PRODUCTION.

The production of talc and pyrophyllite in North Carolina during 1908, 1909, and 1910 were:

For 1908 the production was 3,564 short tons, valued at \$51,443; for 1909 5,956 short tons, valued at \$77,983; for 1910 3,887 short tons, valued at \$69,805. There were seven talc companies producing in the State during 1910. Most of the small producers increased their output, but the production of the principal operators decreased decidedly, so that in the total production of the State there was a falling off of



nearly 35 per cent, or from 5,956 tons in 1909 to 3,877 tons in 1910. These figures for 1910 include both talc and pyrophyllite; there were four producers of pyrophyllite and three of talc. The average price of the talc, including the manufacture of the ground as well as that sold in the rough state at various mines, was over \$17 per ton. The average price of the ground talc per ton was about \$11; that of pyrophyllite was nearly \$10 per ton. As there is very little talc sold in the crude state the values are for the production as it was marketed and it usually represents the manufactured product. In the table below there is given the condition in which the 1907 production was marketed, together with the productions for 1908, 1909, and 1910.

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1907, 1908, 1909 and 1910.

Condition in which Marketed	1907		1908		1909		1910	
	Quantity, Short Tons	Value	Quantity, Short Tons	Value	Quantity, Short Tons	Value	Quantity, Short Tons	Value
Ground talc for powders, etc.....	2,245	\$24,514	2,654	\$25,273	5,601	\$48,499	3,097	\$35,094
Talc cut into pencils, gas tips, etc.	160	43,034	110	23,881	130	28,734	114	31,151
Talc sold crude .....	1,580	5,999	790	1,989	200	600	576	3,050
Soapstone cut into slabs for chimneys, etc.....	100	800	10	300	25	150	100	500
Total.....	4,035	\$74,347	3,564	\$51,443	5,956	\$77,983	3,887	\$69,805

In the following table the quantity and value of talc and soapstone from 1898 to 1910 are given.

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1910, INCLUSIVE.

Year	Quantity	Value	Year	Quantity	Value
	<i>Short Tons</i>			<i>Short Tons</i>	
1898.....	1,695	\$ 27,320	1905.....	4,035	\$ 74,940
1899.....	1,817	31,880	1906.....	4,184	66,979
1900.....	4,522	75,303	1907.....	4,085	74,347
1901.....	5,819	77,974	1908.....	3,564	51,443
1902.....	5,239	88,962	1909.....	5,956	77,983
1903.....	5,331	76,984	1910.....	3,887	69,805
1904.....	3,801	65,483			

### PRECIOUS STONES.\*

During the years 1908, 1909, and 1910 there was little systematic mining for gems in North Carolina, and a number of well-known gem localities were not operated at all. One of the gem minerals for which North Carolina is especially noted is the beryl, and nearly all the gem production during the past three years has been of beryl gems.

\*See also Bulletin No. 12 and Economic Papers No. 6, pp. 50-57; No. 9, pp. 55-62; No. 15, pp. 67-74.

## BERYL.

*Emerald beryl.* During 1909 the discovery of a new emerald prospect in North Carolina was made on the land of Mr. W. B. Turner, 4 3-4 miles south 30° west of Shelby, Cleveland County. This locality was described by Mr. Douglas B. Sterrett of the U. S. Geological Survey in his report\* for 1909 as follows:

A new emerald locality was brought to light in North Carolina during 1909. It is on the land of W. B. Turner, 4¾ miles S. 30° W. of Shelby, near the east bank of First Broad River, in Cleveland County. It is reported two emeralds were found some fifteen years ago about a mile southeast of Mr. Turner's. Little interest was shown in these emeralds locally, and no further prospecting was carried on for them. Mr. George L. English, then of New York, endeavored to find the locality from which these crystals came, but without success. Through the kindness of Mr. English, now of Shelby, N. C., the writer was informed of the recent discovery of promising crystals of emeralds on the Turner place and a trip to the locality was made in December, 1909. Up to that time some ten or a dozen crystals had been found loose on the surface of the ground. These crystals have a fine dark grass-green color. They are more or less checked, and some contain silky internal markings. The largest emerald found measures about 1 by ¾ by ½ inch. It is about half of a crystal split parallel with the length. The other stones range in size down to about a carat in weight in the rough. Some are nearly whole crystals and others are fragments of crystals. All of them are rather strongly etched and striated. One of the crystals was cut into a faceted stone of less than 2 carats weight and reported to have been valued by the lapidary at \$20. This stone is not one of the best of those found and is rather badly flawed. The majority of the emerald crystals are checked and flawed, but there are portions in some of the crystals that would yield small clear gems of fine color. Minerals associated with the emerald crystals in the soil are colorless and smoky quartz crystals and black tourmaline.

The emeralds found loose in the soil come from an area of about 100 feet by 25 feet on a hillside of moderate slope to the northwest. The slope is toward the river on the west about 150 yards and toward a small stream entering the river at about the same distance on the north. The field in which they were found has been cultivated and the emeralds were exposed by plowing and washing by rains. Crystals of quartz and black tourmaline are found at other points on the surface near the emerald prospects. At a point about 150 yards due northeast these crystals occur rather plentifully. Between these points thin seams or shells of chalcedony were found loose in the soil. At the time of visit no development work had been done, and, as the rock outcrops are few and badly weathered, the geology was not well worked out. The locality is in a rather roughly dissected portion of the Piedmont Plateau such as is generally found along the larger creeks and rivers. The elevation is about 680 feet above sea level, or about 30 feet higher than the First Broad River near by. The higher ridges of the Piedmont Plateau in the neighboring country are about 800 to 850 feet above sea level.

The rocks of this portion of the Piedmont Plateau are principally gneisses and schists, of great age, intruded by masses of granite and diorite. In the vicinity of the emerald prospects the types of rock are varied. There are mica, cyanites, garnet, and hornblende gneisses and schists cut by granite or quartz monzonite, gabbro, diorite, and pegmatite. The trend of the rock formations is to the northeast and east of north near the prospect, and west of north a mile farther in that direction. The dip is generally to the south-east.

\*Mineral Resources of the United States for the year 1909, pp. 31-35.



Hornblendic rocks are prominent in the gneisses and schists on each side of the emerald deposit for a distance of a mile or more. These hornblende rocks are, in part at least, metamorphosed phases of the gabbro masses occurring in the region. The gabbro outcrops form large rounded spheroidal boulders of weathering where the rock has not broken down to soil. The granite forms a few ledges of grayish semi-decomposed rock in rather light sandy soil. The gabbro and hornblendic rocks form dark reddish-brown clay soils. The emerald prospect is in a small area of basic rock with granite or monzonite outcrops on either side. Specimens gathered from the surface of the ground consist of gabbro, hornblende or amphibolite after pyroxenite, chloritized amphibolite, and pegmatite. About 20 yards west of the emerald prospect is an outcrop of biotite granite or quartz monzonite. The width of the gabbro belt is over 100 yards, and the rock on the east side is granite or quartz monzonite.

The gabbro outcrops in a few large niggerhead boulders with a grayish-black color and medium grain. Under the microscope the constituent minerals are found to be red-brown hornblende, colorless augite, olivine, bitumens feldspar, biotite, and pyrrhotite. The olivine grains have around them reaction or alteration rims, probably composed of actinolite. The biotite has a strong yellow to reddish-brown pleochroism. The amphibolite was found only in small blocks on the surface and has a greenish-yellow or brown color. The constituent minerals are chiefly pale-brown hornblende with small amounts of augite and iron ores. The hornblende appears to be formed from pyroxene. The chloritized amphibolite has a greenish color and grades into chlorite schist or "soapstone." It is composed of chlorite, green hornblende, actinolite, biotite, iron ores, and small amounts of plagioclase feldspar. The quartz monzonite rock on the west of the prospect is a speckled gray rock of medium grain, composed of quartz, feldspar, and mica, and the field name would be biotite granite. The microscope shows the component minerals to be quartz, andesine feldspar, biotite, muscovite, and a little zircon. The rock should therefore be classed as quartz monzonite.

The gradations from very basic rocks to more acid types in a small area suggest either a basic segregation in the original igneous magma or an inclusion of a basic rock mass in a more acid or granite magma, with an absorption by the latter of part of the former. Results of the latter process are in evidence at numerous localities in the Piedmont Plateau, and the formations of the emerald locality seem to adapt themselves well to this theory. An original mass of gabbro, probably with more basic phases as pyroxenite, was included in a large intrusion of granite magma. The gabbro was broken and blocks of it were floated off and partly or completely absorbed by the granite magma. The latter became more basic near the gabbro mass and graded into it. Thus, rocks ranging from ordinary granite to monzonite, diorite, and gabbro would be formed around the original gabbro. This series may be seen more plainly at other places in the neighborhood. Through the fractures and fissures pegmatitic magmas or solutions passed from the cooling granite into the adjacent rocks, forming pegmatite dikes and veins such as that in which the emeralds have been found.

In April, 1910, and more recently, some prospecting was done at the emerald locality. Mr. English has kindly furnished notes on the results of this work for the following description and loaned a representative collection of wall rock, vein matter, and emeralds for examination. Developments consist of a pit 6 feet deep, a trench 14 feet long started in the hillside to drain the pit, and another trench 25 feet long at a distance of 15 feet northwest of the pit. A pegmatite vein or lens was found, which has a thickness of 30 inches at the surface on the east side of the pit and 18 inches on the west side. In the bottom of the pit the vein has a thickness of about 18 inches on each side. The 25-foot trench was cut to a depth of 3 feet and did not encounter any pegmatite. The vein strikes about N. 70° W. with a dip of 75° N.

The pegmatite is composed of quartz and feldspar, part of which, at least, is albite, with some black tourmaline sprinkled through it and an occasional



emerald or green beryl crystal. The texture of the pegmatite varies from medium-grained to fairly coarse, with nearly pure feldspar and quartz masses 18 inches through. The crystallization is not especially good, though some fairly well developed crystals are found in small rude miarolitic cavities. Crystals found in the cavities are colorless and smoky quartz, albite feldspar, with sometimes black tourmaline and green beryl. The cavities in the pegmatite are partly filled with reddish-brown, greasy-feeling clay, and the same material, along with limonite stains, has permeated joints and seams through the pegmatite. The feldspar of the pegmatite has partly decomposed in places, so that the rock breaks down rather easily. The emerald crystals found in the vein are smaller than most of those found on the surface and have a much paler color. A considerable number of these beryl crystals were found, ranging from pale emerald green to a fairly dark green. Mr. English washed three washtubfuls of partly decomposed vein material and obtained 34 small crystals and fragments of emerald. There were no emeralds visible in this material before washing. The crystallization of the quartz and feldspar so far found in the pegmatite vein is not so perfect as that in the veins once worked for beryl and hiddenite at Hiddenite, N. C. The albite assumes the form of rough crystals and of aggregations of stout crystals, though not of the cleavelandite type common in many gem-bearing pegmatites. The quartz occurs in crystals of average perfection and in many of the specimens exhibits trapezohedral faces indicating a right-hand character. Some of the quartz is nearly colorless and some is smoky colored. One crystal of quartz examined is penetrated by numerous fine light-colored needles, probably actinolite. The emerald crystals are simple hexagonal crystals of beryl with the prism faces and base. Many of them are deeply striated and etched, especially on the prism faces. Other crystals have internal striations or irregularly shaped tubes extending through their length. In some cases these tubes are of considerable size compared with the crystal inclosing them and have been filled with clay or iron stains. The finer tubes appear as silky striations in the crystals. A pretty specimen of emerald in the matrix found in the vein consists of light emerald-green beryl crystal 17 millimeters long and 3 millimeters in diameter embedded in quartz and albite. The emerald is partly embedded in each mineral. The quartz has a light smoky color and is roughly crystallized. The albite also shows rude crystallization and, along with the quartz, is slightly stained with iron. The emerald is transparent, though somewhat checked by flaws. Some of the faces of the prism zone are much striated.

Among the specimens loaned by Mr. English were 16 cut gems. One of these was a faceted table cut stone of 77 milligrams or 0.385 metric carat weight and might be worth from \$5 to \$10. The stone had a flaw in the middle and was light emerald green. The rest of the stones were cut *cabochon* and drop shape and were nearly all dark colored, some of a fine emerald green. All contained checks and flaws or silky striations. The dark-colored stones of this grade might be valued at from \$20 to \$25 per carat. Three drop-shaped emeralds weighed 326, 267, and 251 milligrams, or 1.63, 1.33 and 1.26 metric carats, respectively. These three stones were sufficiently well matched to be used as pendants in a necklace and, though more or less flawed, had a good color. They should be worth at least \$25 a carat. Other gems cut *cabochon* were of better quality, though slightly paler in color than the three drop-shaped stones. Several of the emeralds cut *cabochon* exhibit a fairly good cat's-eye effect along the silky internal striations, very similar to the effect and due to the same cause of the tourmaline cat's-eye from Southern California. The crystal from which the faceted gem was cut was obtained from the pegmatite vein. The other stones with deeper color were cut chiefly from crystals found on or near the surface.

As the prospect pit has been made on the hillside below the point at which some of the emeralds were found and has yielded only gems with a paler color than those found on the surface, it is possible that there is another vein.



Mr. Thomas English, of Spruce Pine, N. C., reports the discovery of a new emerald prospect near the Emerald Matrix mine, on Crabtree Mountain, 4 miles southwest of Spruce Pine, in Mitchell County. The new prospect is about a quarter of a mile north of the old mine and considerably lower down on the side of Crabtree Mountain. Only a few blasts had been put in, and several specimens had been obtained. These crystals are said to have a little paler color than those of the old mine. Some of the emeralds are of pencil thickness though most of them are somewhat checked. The best emerald matrix material is said to be the dark-colored quartz wrapped in scaly biotite.

In the report\* for 1910 Mr. Sterrett writes with regard to this locality as follows:

The locality is a hillside of moderate slope about 30 feet higher than the First Broad River near by. The elevation is about 680 feet above sea level. The rocks of the region are principally gneisses and schists of great age intruded by masses of granite and diorite. In the vicinity of the emerald prospect the types of rocks are varied. There are mica, cyanite, garnet, and hornblende gneisses and schists cut by granite or quartz monzonite, gabbro, diorite, amphibolite, and pegmatite. The emerald occurs in pegmatite cutting and amphibolite. The amphibolite is associated with a mass of basic rock which presents two phases, olivine gabbro and diorite. These rocks are in turn inclosed in biotite granite, and the latter rock includes masses and balls of the more basic rocks near the contact of the two. The several rocks are more or less decomposed near the emerald prospect and some phases of the decayed gabbro and amphibolite are difficult to distinguish from one another. The basic rocks make a dark, reddish-brown clay soil on thorough decomposition, and the granite gives a lighter-colored generally sandy soil. Minerals associated with the emeralds are albite, quartz, clear colorless, and smoky, in some cases, with black tourmaline and actinolite inclusions, black tourmaline, and common green beryl crystals.

At the time of the last examination there were 5 openings and 2 small ones that had been filled up. The largest working consisted of a trench over 100 feet long and from 2 to 12 feet in depth. The next largest opening, about 7 feet east of the trench, was a pit 15 feet long, 9 feet deep, and 7 feet wide. All of the workings were within a space of 50 feet and were in an east and west direction from each other. Decomposed and partly chloritized amphibolite and gabbro were encountered in each cut. In the largest trench 4 or 5 pegmatites were cut, most of them being small. Emeralds were found in one pegmatite only, the other pegmatites containing only quartz and tourmaline crystals. Veinlets of quartz crystals with little if any other mineral, cut the amphibolite. Some of the quartz crystals from these veinlets are very clear and measure 2 inches through. Part are colorless and part smoky brown. The pegmatite carrying the emeralds is lens-shaped with irregularities in direction. In the larger pit it was 30 inches wide at the surface on the east side of the pit and 18 inches wide on the west side. At a depth of 10 feet the pegmatite was about 18 inches wide. An offset or over-lapping lens of pegmatite was exposed in the east face of the pit near the surface. The pegmatite has an irregular strike approximating east and west and a dip of 80° N.

The gem-bearing pegmatite is medium to coarse-grained and is composed of quartz and feldspar, part of which, at least, is albite, with some black tourmaline sprinkled through it and an occasional emerald or green beryl crystal. The crystallization of the minerals of the pegmatite is not good, but a few partly developed crystals are found in small irregular miarolitic cavities. Crystals found in these cavities are colorless and smoky quartz, albite feldspar, with black tourmaline and a little beryl. The cavities in the pegmatite are partly filled with reddish brown, greasy-feeling clay, and

\*Advance chapter from Mineral Resources of the United States, 1910.

the same material along with limonite stains has permeated joints and seams through the pegmatite. The feldspar of the pegmatite has partly decomposed in places, so that the rock breaks down rather easily. Some of the emerald crystals are firmly attached to other minerals and others are loose and may be obtained by washing the semi-decomposed pegmatite. Many small fragments and crystals of emeralds have been found this way, but up to 1911 only a very few pieces of gem emerald had been found in place in the rock, nearly all the gem material having come from the surface.

Mr. George L. English,\* who has assisted Mr. Turner in prospecting for the emeralds, has kindly given the following information on the latest developments at the mine. The main pit has been sunk to a depth of 15 feet on the pegmatite and another pit a few feet to the east has also exposed the "vein." In this pit the pegmatite was about 5 feet wide and had a dip of 15° to 20° to the east. A trench about 10 feet deep and nearly 30 feet east of the main pit has also cut the "vein." Several other prospects on the place have shown the presence of pegmatite but failed to develop emeralds. At one of these, an eighth of a mile southwest of the main locality, an abundance of fine black tourmaline crystals, a little dark green apatite, two unidentified minerals, one a metallic mineral and the other a dark resinous one, and a blue mineral resembling crocidolite were found.

In the main pit a large pocket of emerald crystals was found at a depth of about 10 feet. Most of these were pale colored, but some were nearly equal to the pieces found on the surface. Only a few small pieces have been cut and a faceted stone among these was sold at the rate of \$48 per carat. The largest crystal found measured  $2\frac{1}{4}$  inches long by five-eighths of an inch in diameter, and weighed 26.2 grams. This crystal was broken into four pieces. The color except near the termination is pale and the crystal is deeply striated so that its color does not appear so strong as on broken surfaces. Many of the crystals from this part of the "vein" are opaque inside, but have thin transparent shells of rich green color that would cut into good faceted stones of small size.

*Aquamarine and golden beryl.* The following notes regarding the Joel Walker aquamarine prospect and the Littlefield aquamarine beryl mine are taken from Mr. Sterrett's report.†

The Joel Walker beryl prospect is on a knob one-half mile east of Walker Knob of the South Mountains, 8 miles west of south of Morganton, Burke County, N. C. Beryl crystals have been found at two places here about 200 yards apart. One of these has been opened by a pit 10 feet deep and 18 feet long. This pit is along a pegmatite body striking north and south with an easterly dip. The country rock is mica gneiss cut by granite and has a northeasterly strike. Black tourmaline and small sheets of mica are associated with the beryl in the pegmatite. Both aquamarine and green and golden beryl were found in this opening. At the other locality numerous small yellow and golden beryls up to the diameter of a pencil in size have been found in boulders of pegmatite on the mountainside. Some of these crystals are clear and have very rich colors. Much of the beryl observed from these deposits was rather badly checked and flawed, though some crystals were seen that would yield cut gems of about a carat in weight. Larger clear stones are reported to have been found. From the small amount of development the showing seems favorable.

Other beryl prospects have been found in the South Mountains. One prospect, a mile east of the Walker prospect, has yielded crystals of good aquamarine color and three-fourths of an inch in diameter, with portions clear enough for cutting.

\*Dated, Shelby, N. C., June 2, 1911.

†Advance chapter from Mineral Resources of the United States for the year 1910.



The Littlefield beryl mine is on the headwaters of Tessentee Creek, 1 mile south of Whiterock Mountain, Macon County, N. C. The last work at this mine was in 1902. The vein was removed by an open cut 135 feet long and from 10 feet deep at the northeast end to 25 feet deep at the southwest end. Another open cut 20 feet long and 10 feet deep, a few feet southwest of the main one, showed that the vein had been offset about six feet to the west. The country rock is biotite granite gneiss, porphyritic in places, and strikes N. 40° E. with a 40° SE. dip. The beryls were found in a pegmatite ledge cutting across the granite gneiss with a strike of N. 40° E. and a dip of 85° SE. The greater part of the pegmatite removed in the open cut varied from 3½ to 5 feet in thickness. At the southwest end of the cut the pegmatite pinches down to 8 inches in thickness. Clear aquamarine, green and golden beryl, ranging from needle-like specimens to three-fourths of an inch in diameter and 2 or more inches in length, was obtained at this mine. These crystals furnished very beautiful gems as well as some good specimen material.

Beryl crystals are found on a ridge near the home of R. E. Brown, 1¼ miles S. 25° E. of the point where Johns Creek and Caney Fork join in Jackson County, N. C. A small pit was opened in search of mica on the outcrop of a partly decomposed pegmatite. About a dozen beryl crystals were found in this pit. The crystals ranged up to nearly 1 inch in diameter and 2 inches in length. Some of them were transparent in places and of a fairly good aquamarine color. If crystals with larger clear portions and of the same color could be found, they would be suitable for gems.

The beryls are found in kaolinizing feldspar, associated with quartz and a little black tourmaline. The country rock is mica gneiss, badly decomposed, with which the pegmatite seems to be conformable. To the west a short distance is a band of staurolite schist, and to the northeast chloritic soapstone.

In 1908 it was reported that the Virginia-Carolina Gem Company, of Shenandoah, Virginia, was carrying on some prospecting work on its aquamarine deposit near Mica, Mitchell County. The mine adjoins the property of the American Gem and Pearl Company and is probably the old Hungerford mine.

#### THULITE.

Another precious stone that was mined in North Carolina during 1908 to a certain extent was thulite or rose-colored zoisite, which is found in the mica mines associated with feldspar, with which it forms patches and groups of crystals, sometimes radiated. Thulite is found at the Flat Rock mine, and furnishes attractive gems when cut *en cabochon* with the inclosing feldspar.

#### AMETHYST.

Amethyst has been found at several localities in Macon County, North Carolina, and several prospects in mines have been opened in the valley of Tessentee Creek. Other deposits have been found a few miles southeast of these on the south side of the Blue Ridge.

Of the deposits in the valley of Tessentee Creek, the Connally Mine has been worked by the American Gem and Pearl Company of New York, and the Rhodes Mine by the Passmore Gem Company of Boston. Other amethyst mines in North Carolina are located on the

lands of William Long, John Justice, and J. B. Justice. Below is given a brief description of the Connally Mine and the William Long prospect, taken from the 1910 report of Mr. Douglas B. Sterrett.\*

*Connally Mine.*—The Connally mine is on the north side of the valley, about 2 miles N. 55° E. of the mouth of Tessentee Creek, in Macon County. The workings extend over 100 yards northward up a steep mountain side, from an elevation of about 2,600 feet to nearly 2,800 feet above sea level. They consist of prospect pits and tunnels with irregular stopes. Some of the tunnels are over 100 feet long.

The country rock is garnetiferous mica gneiss cut by fine biotite granite gneiss, in both of which pegmatite occurs. The strike of the gneiss as measured in some of the openings was N. 10° to 35° E. and the dip was almost vertical. The amethyst vein cuts across the gneiss with a strike of N. 40° W. and a vertical dip. Local variations in strike occur where the vein follows irregular contacts between the garnet gneiss and the granite gneiss, which, in these places, form the walls of the vein. In other places the vein lies either in garnet gneiss or in granite gneiss. In most of the openings the vein consists of a single seam with pockets of amethyst crystals at irregular intervals. The pockets are more or less lenticular in shape and range from 1 to 12 inches in thickness, and from a few inches to several feet in length. Many of the pockets are filled with yellowish-red and dark-red clay, though some contain cavities. The amethyst crystals line the walls of the pockets, have become detached and lie loose, or are imbedded in the clay of the pockets. Portions of the vein with the pockets and seams joining them form channels for a small flow of water in wet weather, which probably furnishes the clay of the pockets by decomposing the rock along its course. In one prospect two veins were exposed, cutting decomposed granite gneiss. The granite gneiss along one of these veins was more decomposed and more heavily stained with iron than that adjoining the other. The vein in the decomposed rock contained much yellowish-red clay with some amethysts of a fair color. In the other vein only pale amethystine quartz crystals were found.

Seams of small quartz crystals, sometimes in pockets, branch out from the main vein in places, though no amethysts were observed in them.

The amethyst crystals range from a fraction of an inch to over 2 inches in thickness. Most of them have only a pale amethystine color and some are nearly colorless quartz. The purple color of the amethysts is not uniform throughout the crystals, but is generally richest near the points and is often arranged in layers of varying intensity parallel with the crystal faces. Only a small percentage of the crystals yield very dark purple gem material that will cut into stones weighing several carats.

*William Long Prospect.*—The William Long prospect is between two prongs of the headwaters of Tessentee Creek, 4½ miles east of its mouth. An open cut 30 feet long in an east and west direction with a maximum depth of 8 feet was made on a vein of amethysts. The country rock is granite. The granite on the north side of the cut is partly altered, somewhat porphyritic biotite granite. The granite on the south side and closely connected with the amethyst vein is badly altered and is pinkish yellow. In a thin section under the microscope the following minerals were observed in this rock: Quartz in irregular grains and veinlets, muscovite, aggregates of fine decomposition products, apparently sericite, replacing original feldspars, and hematite stains. This rock is probably an altered form of the country granite. The amethyst vein is reported to vary from less than an inch to 8 inches in thickness, and to have an east-west strike with a high northerly dip. No work was in progress at the time of examination, and only the

\*Advance chapter from Mineral Resources of the United States for the year 1910.



poorer specimens of amethysts were seen on the dump. These consisted of crystals ranging from a fraction of an inch to  $1\frac{1}{2}$  inches in thickness. They were mostly pale amethystine in color, though fairly dark-purple crystals are reported to have been found.

Amethyst is reported to have been found on the land of John Justice, about two-thirds of a mile southeast of the Long prospect, and on the land of J. B. Justice, about three-fourths of a mile southwest of the Long prospect.

#### GARNET.

Garnet for abrasive purposes has been mined in North Carolina and occasionally garnets of gem value have been obtained. The following description of a locality in Burke County from which garnet gems have been recently obtained is taken from Mr. Sterrett's report\* for 1910.

Garnet crystals for abrasive purposes and occasional gems have been obtained from a deposit 8 miles in a southeasterly direction from Morganton, along Laurel Creek, Burke County, N. C. They are a calcium free, iron magnesium garnet belonging to the pyrope type. The color is a deep pink to rich wine red, and some good gems especially for carbuncle cuts, have been obtained from them. These garnets occur in slightly graphitic schist, which is both micaceous and cyanitic in places, and is a member of the Carolina gneiss. They are closely associated with a pyroxenite rock and occur in the schist at or near the contact with this rock. The pyroxenite occurs in lenticular and rounded masses of various sizes in the schist. These masses range from less than a foot across up to many yards in thickness. In many cases the pyroxenite has altered to chloritic soapstone to a depth of several feet from the surface. There has been contact action between the pyroxenite and inclosing schists, as shown by the presence of chlorite zones between them.

The garnets occur scattered through or in streaks in the schist, either at the contact with the pyroxenite or at a distance of several feet from it. The garnets range in size from a fraction of an inch to 3 or 4 or more inches in diameter. Many of them, especially those near the surface, have been badly decomposed, and in some cases entirely so, and have passed into reddish-brown earthy masses. The garnets occur in the bedding of the schist which they have forced apart, so that it assumes an augen shape around the crystals. This augen effect is very striking in some cases where small masses of kaolinized feldspar occur in the augen on each side of the garnet.

#### PRODUCTION.

The values of the productions of precious stones of all kinds in North Carolina for the years 1908, 1909, 1910 respectively are: For 1908 \$570; for 1909 \$479; and for 1910 \$700. These are only approximate figures as it is impossible to obtain absolutely accurate figures regarding the production of precious stones on account of the dealers buying the rough material keeping no record of what has been purchased.

\*Advance chapter of Mineral Resources of the United States for 1910.

In the table below is given the production of North Carolina for the years 1900-1910 inclusive.

PRODUCTION OF PRECIOUS STONES IN  
NORTH CAROLINA SINCE 1900.

Year	Value
1900.....	\$ 12,020
1901.....	24,245
1902.....	5,300
1903.....	1,525
1904.....	10,600
1905.....	3,350
1906.....	5,000
1907.....	7,580
1908.....	570*
1909.....	479*
1910.....	700*

\*Estimated by U. S. G. S.

### MINERAL WATERS.†

A mineral water is any spring or well water sold as water for table or medicinal use, whether still or carbonated, in bulk or in packages. In collecting statistics for mineral waters it is hard to decide just what should be included as mineral water as distinguished from the natural spring waters sold for mineral purposes. The plan adopted by the U. S. Geological Survey has also been adopted by the State Survey because of the collecting of statistics by the two surveys on a coöperative basis, and is outlined below:‡

"In distinguishing between what to include and what to exclude, a somewhat arbitrary rule was necessary because of the great variety of natural waters, the widely different methods by which they are prepared for market, the many purposes for which they are sold, and of the gradations between strictly natural and strictly artificial waters. In general, the decision was based on commercial rather than scientific grounds, so that although the figures of output include waters that differ widely in mineralization, they do not include any water sold for public supply nor any that is essentially artificial. Hence the statistics cover the output of both natural waters, those bottled just as they flow from spring or well, and of what may be called semi-natural waters; that is, natural waters that have been strengthened by evaporation, treated to prevent the deposition of iron, or carbonated by gas obtained from the spring or well or by gas made artificially. Both the natural and the semi-natural waters fall into two classes, table and medicinal.

"The waters excluded from the tables given in this report are of

†The mineral waters of the State have been described in detail in Economic Paper No. 15, 1903, pp. 74 to 145.

‡United States Geological Survey, Mineral Resources for 1909.



many kinds. They comprise the strictly artificial drinks, both the artificial vichy and seltzer and other artificial table waters and the various proprietary remedies that may be called medicinal waters; all water distributed by public supply systems; and all water furnished free or at a nominal charge to guests at hotels and sanitariums for drinking or bathing. The sweetened beverages or soft drinks are not classed as mineral waters and are of course excluded."

In the report for 1907 there was given analyses and the mineral content of a large number of the mineral springs of the State. Several springs that are now shipping mineral water were not described in the report for 1907 and a brief description of them is given here.

*Derita Mineral Springs.* This spring is located in Mecklenburg County, near the village of Derita. There are a number of springs on the property, but the chief spring and the one from which the water is shipped is known as Spring No. 2. No quantitative analysis is available of this water, but a qualitative analysis made by Dr. H. B. Battle, shows the water to contain 9 grains of solid matter per gallon, consisting chiefly of calcium sulphate ( $\text{Ca SO}_4$ ). This analysis shows it to be a calcic water. There is also present in much smaller quantities potassium chloride, sodium chloride, magnesium chloride, magnesium sulphate, sodium carbonate and iron oxide.

*Sherrill or Sossaman Springs.* These springs are situated near Harrisburg, Cabarrus County, and are operated by the N. J. Sherrill Mineral Springs Company of Charlotte, N. C. Spring No. 2 is the one that furnishes the mineral water for shipment. The following analysis made by Mr. E. E. Randolph, of the University of North Carolina, shows the chemical composition of the water:

Calcium Sulphate .....	20.841
Calcium Bicarbonate .....	3.175
Iron Carbonate (Ferrous) .....	6.201
Iron Sulphate .....	2.010
Sodium Sulphate .....	4.025
Sodium Chloride .....	1.172
Potassium Chloride .....	.832
Magnesium Sulphate .....	.017
Silica .....	.121

The total solids in each gallon of water is 38.398 grains. Mr. Randolph states in regard to this water that it is pure "so far as free from albuminoid, ammonia, nitrates and typhoid bacteria are concerned; also free from organic matter."

On account of the distance of this spring from the railroad it has not been developed to the extent that the character of the water justifies, but the owners expect the car line to pass near the spring very shortly, when its production will be largely increased.

*Rocky River Springs.* These springs—four in number—are situated in Stanly County, seven miles west of Norwood, and twenty miles north of Wadesboro. Hack lines are operated between these points and the Rocky River Springs Hotel. The springs are named according to their predominating or characteristic constituent and are known as the Arsenic Spring, Iron Spring, Sulphur Spring, and Magnesia Spring. Each of these springs is carefully enclosed and well kept. They have been developed and splendid accommodations have been provided for guests in the Rocky River Springs Hotel and Annex. The location is delightful and the place is patronized as a summer resort.

#### PRODUCTION.

The productions of mineral waters in North Carolina during the years covered by this report are given as follows:

1908.

The North Carolina output of mineral water decreased in 1908 in spite of about 30,000 gallons sold by springs reporting for the first time. The sales were reported as 160,195 gallons, valued at \$27,163 as compared with 193,479 gallons, valued at \$40,302 in 1907, a decline of 17.20 per cent in quantity and 32.6 per cent in value. Four new springs reported a production: Derita Mineral, Lincoln, Sherrill's Mineral, and Smith Mineral, making the total number of springs reporting 18. Nearly 90 per cent of the total output of the State is used for medicinal purposes. Resorts are situated at eleven of the springs, with accommodations for nearly 1,500 people, and at 8 the water is used for bathing purposes. In addition to the sales there were 11,200 gallons used in the manufacture of soft drinks. The 18 springs reporting in 1908 were as follows:

All Healing Spring, Alkalithia Springs, Alexander County.  
Barium Rock Spring, Barium Springs, Iredell County.  
Buckhorn Lithia Springs, Bullock, Granville County.  
Cleveland Springs, near Shelby, Cleveland County.  
Derita Mineral Spring, near Charlotte, Mecklenburg County.  
Haywood White Sulphur Spring, near Waynesville, Haywood County.  
Hot Springs, Hot Springs, Madison County.  
Jackson Springs, Jackson Springs, Moore County.  
Lincoln Lithia Spring, Lincolnton, Lincoln County.  
Mida Spring, near Charlotte, Mecklenburg County.  
Moore's Springs, Moore's Springs, Stokes County.  
Mount Vernon Springs, Mount Vernon Springs, Chatham County.  
Panacea Spring, near Littleton, Warren County.  
Seven Springs, Seven Springs, Wayne County.  
Sherrill Mineral Spring, near Harrisburg, Cabarrus County.  
Sparrow's Spring, Kings Mountain, Cleveland County.  
Vade Mecum Spring, Vade Mecum, Stokes County.



## 1909.

Owing to the smaller number of springs reporting sales during 1909 the output and the value for this year were less than in 1908. The sales reported by spring owners during 1909 amounted to 128,171 gallons, valued at \$20,558, against 160,195 gallons, valued at \$27,163, reported in 1908, a loss of 32,024 gallons, in quantity, and of \$6,605 in value. The average selling price decreased from 17 cents to 16 cents per gallon. Three new springs reported—the Huckleberry, Kuidene, and Rocky River. The total number reporting was 15, or three less than in 1908. Several were idle or out of business, and 2 declined to make returns. The greater part of the water sold is used medicinally. At 9 of the springs are resorts, accommodating nearly 1,500 people, and the water at 2 is used for bathing. Only a small quantity was reported used in the manufacture of soft drinks. The following springs made returns of sales for 1909:

All Healing Springs, Alkalithia Springs, Alexander County.  
 Buckhorn Lithia Springs, Bullock, Granville County.  
 Derita Mineral Springs, near Derita, Mecklenburg County.  
 Hot Springs, Hot Springs, Madison County.  
 Huckleberry Springs, Durham, Durham County.  
 Jackson Springs, Jackson Springs, Moore County.  
 Kuidene Spring, Polk County.  
 Mida Spring, near Charlotte, Mecklenburg County.  
 Moore's Springs, Moore's Springs, Stokes County.  
 Mount Vernon Springs, Mount Vernon Springs, Chatham County.  
 Rocky River Springs, Rocky River Springs, Anson County.  
 Seven Springs, Seven Springs, Wayne County.  
 Sherrill (or Sossaman) Mineral Spring, near Harrisburg, Cabarrus County.  
 Smith Lithia Spring, Oxford, Granville County.  
 Vade Mecum Spring, Vade Mecum, Stokes County.

## 1910.

The same number of springs reported for 1910 as for 1909; that is, 15. The sales reported by spring owners amounted to 143,007 gallons, valued at \$21,389, an increase of 14,836 gallons, valued at \$831, as against 128,171 gallons, valued at \$20,558 in 1909.

The following springs made returns of sales for 1910:

All Healing Springs, Alkalithia Springs, Alexander County.  
 Buckhorn Lithia Springs, Bullock, Granville County.  
 Derita Mineral Spring, near Derita, Mecklenburg County.  
 Huckleberry Spring, Durham County.  
 Jackson Springs, Jackson Springs, Moore County.  
 Mida Springs, near Charlotte, Mecklenburg County.  
 Moore's Springs, Moore's Springs, Stokes County.  
 Mount Vernon Springs, Mount Vernon Springs, Chatham County.  
 Sherrill (or Sossaman) Mineral Spring, near Harrisburg, Cabarrus County.  
 Smith Lithia Spring, Oxford, Granville County.  
 Vade Mecum Spring, Vade Mecum, Stokes County.

Barium Rock Springs, Barium Springs, Iredell County.  
 Haywood White Sulphur Springs, Waynesville, Haywood County.  
 Panacea Springs, Littleton, Halifax County.  
 Shelby Lithia Springs, Shelby, Cleveland County.

In the following table there is given quantity and value of mineral waters shipped for the years 1901-1910 inclusive.

PRODUCTION OF MINERAL WATERS IN  
 NORTH CAROLINA SINCE 1901.

Year	Amount, Gallons	Value
1901.....	375,700	\$ 42,167
1902.....	104,400	18,795
1903.....	83,100	13,085
1904.....	145,800	21,902
1905.....	201,000	38,755
1906.....	158,680	31,413
1907.....	193,479	40,302
1908.....	171,395	27,163
1909.....	128,171	20,558
1910.....	143,007	21,389

### GRAPHITE.\*

Most of the graphite of North Carolina is of the amorphous variety and the market for it is of necessity limited. The principal use that has been made of it in the past has been for foundry facings. There has been none of this mineral, however, shipped since the year 1907. In the following table there is given the production of graphite from 1901 to 1910, inclusive.

PRODUCTION OF GRAPHITE IN NORTH  
 CAROLINA FROM 1901 TO 1910.

Year	Quantity	Value
	<i>Tons</i>	
1901.....	95	\$ 559
1902.....	830	4,309
1903.....	50	248
1904.....	100	525
1905.....	100	475
1906.....	100	475
1907.....	-----	-----
1908.....	-----	-----
1909.....	-----	-----
1910.....	-----	-----

### COAL.

No coal production was reported for the years 1908, 1909, and 1910. There are two areas in North Carolina in which coal occurs. Both of these are in the Triassic formation and are of the same geologic

\*See description of graphite deposit of North Carolina in Economic Papers No. 6, pp. 68-69 and No. 9, pp. 62-64.



age as the Richmond coal basin of Virginia. The two areas are known as the Deep River and the Dan River fields, being named from the two rivers which drain them.

#### DAN RIVER FIELDS.

An examination has been recently made by the U. S. Geological Survey of the Dan River District in Stokes and Rockingham counties to determine whether or not it contains any important coal beds. The work was done by Mr. R. W. Stone, who examined all the known prospect pits and had a number of them reopened. It was found that the coal bearing rocks consist of a narrow belt of black slaty shale, which extends from a point just north of the Virginia line southwestward through Leaksville, Madison, and Walnut Cove, to Germanton. It has been thought by those living in the district that these black shales would lead to good coal with depth. This is not warranted by fact, however. At a few places on Dan River in the black shale belt, thin beds of hard semi-anthracite coal have been found. This coal disintegrates very slowly, and consequently should be as thick at the surface as it is underground. Scarcely more than a foot of good coal has been found in any one bed in the district in a distance of thirty miles along the outcrop, a fact which further diminishes the probability of finding thicker beds below the surface.

The black shale is well exposed at the bridge over Dan River half a mile below Leaksville, in the streets of Madison, and in the railroad cut on the county line at the mouth of Carter Creek. But in none of these places does it show any sign of coal. The beds dip to the northwest at angles ranging from  $20^{\circ}$  to  $60^{\circ}$ , so that a prospect becomes a slope and in this district all slopes have to contend with a large amount of water.

During the Civil War coal was mined on the Wade plantation three miles above Leaksville and shipped by boat to Danville. Although the coal is semi-anthracite, the bed is so broken up by shale partings and so small in its extent that operations were soon discontinued. Subsequent prospecting on either side of the old pits show that the bed is a small lens and carries only a few inches of coal. More than 50 pits have been dug within three miles of Walnut Cove in search of coal. High grade coal has been found, but it is nowhere more than a few inches in thickness.

A bed of what appears to be soft flaky coal has been found in several places in the vicinity of Walnut Cove. This material is bright black and looks like some form of coal, but it is most likely only coal shale. Its soft and flaky character seems to be due to crushing that

has produced widespread effects in this region, and it will probably be found in the same soft condition even where it lies at considerable depth. As this coaly shale is of the same character for several miles along the outcrop, there is no reason to suppose that it changes to coal down the dip of the beds where it is under greater cover. Mr. Stone sunk a pit half a mile south of Walnut Cove and found that this bed is at that point more than 10 feet thick. Analyses show that it contains a high percentage of ash and thorough tests prove that it will not burn and therefore has no coal value.

Half way between Walnut Cove and Germanton, several large pits have been dug and some coal has been recovered from a bed of semi-anthracite less than one foot thick. This coal rests on coaly shale, which is so bright and black that it has been mistaken for coal, and which is known in Walnut Cove as the "soft coal vein." It is not coal, however, and there is no reason to believe that it has been changed to coal even where it lies at great depths.

Mr. Stone's conclusion is that there is no reason to expect to find commercial coal beds in the Dan River District. The beds of semi-anthracite found there are only local. They are of small lateral extent and only a few inches thick.

#### DEEP RIVER FIELDS.

The Deep River Coal Field, which occurs in Moore and Chatham counties, was thoroughly examined by Dr. H. M. Chance, of Philadelphia, in 1884-85, and a very elaborate report was made by him to the North Carolina Department of Agriculture, and published by them in 1885.

As the Survey is constantly receiving inquiries regarding the coal deposits of the State, the conclusions reached by Dr. Chance are given below:

"1. That a bed of coal of good quality free from slate may be considered workable in this district if twenty-two or twenty-four inches thick.

"2. In the area between Farmville and Gulf, a distance of about four and a half miles, two beds of coal exist that may be considered workable; that these beds are not of workable thickness and quality over all of this area, but are subject to the occurrence of deteriorated patches in which the beds are poor and thin; that it is not unlikely that the workable areas are disconnected, that is, the coal may not be continuously workable from one locality to that next adjoining.

"3. That the most promising area seems to be that lying between the openings on the Taylor place and Egypt.



"4. That the disturbances occasioned by trap-dykes and the presence of the dykes are serious impediments to successful mining.

"5. That the coal found in the above described area is often sufficiently good to insure ready sale, but that to make and maintain a reputation that would insure a market it might be necessary to leave untouched those parts of a mine in which the coal was rather more sulphurous or more slaty than the average.

"6. That it will be unsafe to attempt opening any property for mining until it has been thoroughly explored by bore-holes, and the position and extent of trap-dykes, faults and other irregularities thoroughly determined.

"7. That in the above described area the prospects are sufficiently encouraging to warrant a thorough exploration of each individual tract by the landowners.

"8. That in the present state of development the prospect does not justify the present owners in asking nor purchasers in paying for the land a sum much in excess of its value for farming purposes.

"9. That in the area east from Farmville and southwest from Gulf the developments do not justify further expenditures in search for coal. This conclusion is subject to one qualifying exception, namely: If a market could be found for the anthracite coal of the Evans, Gardner and Wilcox places at a price approximating that commanded by Pennsylvania anthracite for domestic use, these coals could be worked, but the margin of profit would be precariously small and the output necessarily limited. To properly mine and prepare these coals for domestic use would require a method of preparation similar to that used in the Pennsylvania anthracite coal field. The coal must be broken, sized, screened, picked for slate and perhaps jigged. The cost would probably exceed three dollars per ton. The coal would not be likely to sell for more than three-fourths the price of Pennsylvania anthracite."

There are many obstacles to the successful mining of this coal, as have been experienced by the several companies which have operated in this district. Attention was called to this by Dr. Chance as follows:

"As knowledge of the obstacles presented by this coal field is of great importance they will be described seriatim in the following order:

- a.—Variations in thickness and quality.
- b.—Faults.
- c.—Trap-dykes.
- d.—Presence of explosive gas—fire-damp.
- e.—Water.
- f.—Spontaneous combustion (?)
- g.—Absence of coal from some areas.

"a.—*Variations in thickness and quality.*—These have already been described. These variations are commonly abrupt, the coal suddenly shrinking to one-half or one-third its normal size, and singularly enough, the ash seems to increase in inverse ratio as if all the impurities found in the bed where three feet thick were also present when the coal measures only one foot. This phenomenon is not peculiar to this coalfield as I have noticed it at several localities in Pennsylvania. Such irregularities will prove fatal to the financial success of any operation unless their existence is known and their limits thoroughly defined in advance of actual mining, for it seems absolutely essential to plan the work in advance with reference to these variations.

"b.—*Faults.*—Rolls and displacements of the coal measuring a few feet were found in the workings at Egypt and Farmville. In mining the coal for the Raleigh Exposition we encountered two local rolls. Extensive developments might disclose the existence of greater dislocations which would materially increase the cost of mining,—however, the faults known to exist, aside from those caused by trap-dykes, would not seriously interfere with successful mining.

"c.—*Trap-dykes.*—At many points the coals are intersected by dykes as shown by the Farmville, Egypt and Gulf workings, and they seem to be the most serious obstacles yet encountered. It seems of the utmost importance that the exact position and extent of these dykes should be determined upon any property before planning its development. This can only be accomplished by a complete system of boreholes dotted over all the area to be worked, as is being done at present by the owners of the Gulf property. This is the only safe method.

"d.—*Fire-damp.*—The presence of fire-damp is proven by the occurrence of several explosions at the Egypt shaft. I am informed that "blowers" of gas were frequently struck. In mining a bed of this (three feet) thickness the presence of gas must increase the cost of mining, for it necessitates the establishment and maintenance of large airways to secure adequate ventilation to dilute and carry off the gas.

"e.—*Water.*—These rocks do not carry very large quantities of water, and it is not likely that heavy pumping machinery would be needed.

"f.—*Spontaneous combustion.*—In the Richmond coalfield great trouble has been caused by what is called spontaneous combustion. Judging from the similarity of the coals it seems possible that this same difficulty may obtain here. While this is a mere supposition, it is one that can not safely be ignored. Mine fires are such serious disas-



ters that every possible precaution should be taken to prevent them, and when there is any reason to suspect the possibility of spontaneous combustion, it seems to anticipate the danger by any possible precautionary measures that can be taken.

"g.—*Absence of coal over certain areas.*—The failure to find the outcrop of the coal between Egypt and the Taylor place and between the latter place and the Gulf workings, and the demonstrated absence of the coal on parts of the Farmville property are sufficient evidence that over some areas the coal is entirely absent. It has not been possible to define the exact limits of such areas. This must be done by the individuals or companies owning or operating each tract. To ignore the existence of such barren areas and to plan developments upon the assumption of a continuous unbroken bed of workable size would be to invite failure, and as such a plan would inevitably be followed by disheartening failures in many if not in every case, it seems necessary to determine the exact limits of such areas in advance of developments and before the coal is actually opened for mining. A complete series of bore-holes is necessary to give this information, and these holes must be located only short distances apart."

As will be seen from the above, even in 1885 there was considerable doubt as to the real commercial value of these coal deposits, and, although one mine was worked for a number of years, it was not profitable mining, and it is very doubtful if, considering the quality of the coal and the many obstacles to be overcome in mining it, whether these narrow seams of coal can be mined at a profit for many years to come.

In the table below is given the coal that has been produced in North Carolina since 1890, when the Cumnock mine was reopened.

COAL PRODUCTION IN NORTH CAROLINA FROM 1890 TO 1910.

Year	Quantity	Year	Quantity
1890.....	10,262	1901.....	12,000
1891.....	20,355	1902.....	23,960
1892.....	6,679	1903.....	17,309
1893.....	17,000	1904.....	7,000
1894.....	16,900	1905.....	1,557
1895.....	24,900	1906.....	-----
1896.....	7,813	1907.....	-----
1897.....	21,280	1908.....	-----
1898.....	11,495	1909.....	-----
1899.....	26,896	1910.....	-----
1900.....	17,734		

#### PEAT.\*

Because of the rather extensive peat deposits existing in Eastern North Carolina, the development of the peat industry continues to be

\*See also Economic Paper No. 15, pp. 146-162.

one of interest to this State. In Economic Paper No. 15 there was given a preliminary report on the peat deposits of North Carolina, prepared by Mr. Chas. A. Davis of the U. S. Geological Survey. While nothing new has developed in regard to the peat industry in North Carolina since the publication was issued, it will probably be of value to those interested in the development of peat to have Mr. Davis' report recently published by the U. S. Geological Survey in regard to the development of the peat industry, which is given below.

#### NOTES ON PEAT INDUSTRY.\*

BY CHARLES A. DAVIS.

Noteworthy progress was made in 1910 in the production of peat fuel in other countries than the United States, not only in the quantity actually marketed but also in methods of production and utilization. In the United States, although it is generally known that there are large quantities of material good for fuel in the peat bogs and swamps of the northern and eastern parts of the country, but little progress has been made in developing this resource on a commercial scale.

Earnest efforts to do this have been made in many places through a long series of years, however, and as failure to get satisfactory returns may be attributed more to ignorance of European progress and methods than to any other one cause, it is thought that a brief summary of the progress already noted may be of value to the owners of peat lands and to others interested in peat utilization in the United States.

*Peat must be dried.*—Peat must be dried to be successfully used as fuel, because the raw material in undrained deposits has a water content of 85 to 95 per cent or more so closely associated with it that the moisture can only be reduced to a usable degree by evaporation. This larger percentage of water must be dug and be manipulated with the peat to separate from it the relatively small quantity of finished product obtainable, for which only a low price can be expected, because coal and other satisfactory fuels already supply the fuel markets.

*Peat must be reduced in bulk and increased in density.*—If it is to be used as fuel in furnaces of the ordinary patterns, peat must not only be dried, but it must also be reduced in bulk and increased in density. This is most quickly and cheaply done by grinding to a pulp the wet raw material in machines designed for the purpose. This treatment destroys the fibers and other plant remains in the peat, compacts it, hastens drying, and makes it less friable and brittle when dry. Drying is most certainly and cheaply done by exposing the peat pulp in the form of bricks to the air without application of artificial heat.

*Storing.*—After thorough drying peat fuel that has been treated as described may at moderate cost be transported, stored, and used at places reasonably remote from points of production.

*Erroneous Methods.*—This brief statement serves to epitomize the essentials of the production of peat fuel for domestic use and for the usual forms of power generators. It may be added, however, that millions of dollars in the aggregate have been spent in trying to devise ways to take the wet raw material as it lies in the bog and, by mechanical plants and artificially generated heat, to dry and compact it in a series of operations lasting but a few minutes. These devices have included machinery for de-watering the peat by great direct pressure, by filter presses, by centrifugal machines, by electrical treatment, and by combinations of two or more of these methods. Numerous forms of driers using direct heat or steam heat, either specially

\*Advance chapter from Mineral Resources of the United States, U. S. Geol. Survey, 1910.



generated or derived from the exhaust from machinery used primarily for other purposes, have been built for drying peat. None of these mechanical plants have been successful, and a thorough analysis of the probable cost of operation as compared with a safe estimate of the selling price of the product would have shown at the outset that such complicated plans were likely to prove unsafe investments.

At the time when European engineers were so successful in commercializing the production of fuel briquets from lignites and coal mine refuse, many attempts were made to produce briquets from peat by methods identical with or similar to those in use for briquetting lignite. In general these attempts were unsuccessful although at least two factories of good capacity were reported to be producing peat briquets commercially in Germany quite recently.

In this brief review it is not possible to summarize all of the plans proposed for making peat into fuel, nor to mention the many complicated and expensive types of machinery that have been designed and constructed for drying and reducing peat to powder in order that equally complex machines might shape it into compact and pleasing forms.

#### TENDENCY OF EUROPEAN PROGRESS IN PRODUCTION OF PEAT.

The present tendency in the production and use of peat fuel in Europe is towards simplicity. The development and use of elaborate and costly plants is no longer attempted, and the simplest practicable product that can be used efficiently is sought and made. The simplification of processes for making peat fuel has extended to the development of machinery to decrease the employment of hand labor, which, even in regions where laborers are numerous and can be hired at low wages, has hitherto been a source of high cost of production and of restricted output.

The real progress, that which has been demonstrated in plants of commercial size, may therefore be classified under two general heads—methods of increasing production of the fuel itself and methods of deriving more power from the fuel in proportion to the quantity used—that is, of increasing its efficiency. The two lines of progress noted are evidently interdependent, because so long as production is limited, from any cause, use must be limited also. On the other hand, if there is restricted use for any reason, unrestricted production will soon overstock the market and become unprofitable.

*Gas Producers and Gas Engines.*—For several years past reports of the successful use of peat fuel in gas producers of several types have been published and in this use, apparently, the greatest progress has been made in utilizing peat fuel as a source of power of great possibilities.

It now seems demonstrated beyond any reasonable doubt that gas engines of the explosive type consuming producer gas may be used with entire success for generating power in any quantity that may be needed. Such engines can be run with high efficiency when supplied with gas of very low heat value, generated from fuels of grades that could not be used as fuel for steam boiler firing, if the gas is furnished to the gas engines in right quantity and is of fairly uniform chemical composition. Moreover, the individual gas engine has been increased in size until it is now comparable in horsepower developed with the largest steam engines.

Gas producer plants of large capacity generating power or fuel gas are much more frequent in European countries than in the United States, although in this country both gas engine and gas producer are replacing the steam engine and boiler to a surprising extent in many types of plants.

The gas producer is essentially a vertical furnace in which a part of the fuel, in a very thick fuel bed, is entirely consumed by combining its combustible elements with the oxygen of a carefully controlled supply of air to develop heat enough to convert the rest of the fuel into free hydrogen and carbon compounds which can be still further made to combine with oxygen with the liberation of heat.

The gas thus developed is called producer gas and is, essentially, a mix-



ture of gases, of which hydrogen and carbon monoxide are the important fuel constituents, and nitrogen from the introduced air and carbon dioxide the diluents.

*Sulphate of Ammonia.*—In addition there are various solid and liquid impurities derived from the fuel during the generating process, which must be removed by washing the gas before it can be used profitably in gas engines; this cleansing is not needed if the gas is used as fuel. Among the substances present in producer gas as it leaves the generator are some which have commercial value. The most readily salable of these is ammonia, which is derived from the combined nitrogen originally contained in the fuel. This may profitably be recovered and fixed as sulphate of ammonia if the quantity of gas generated is large enough to warrant the cost of installing and operating the special form of apparatus needed for the processes involved in combining the ammonia present in the producer gas with sulphuric acid and for the subsequent concentration and purification of the salt on a large scale. The recovery of ammonia as a by-product of gas-producer plant has not generally been found profitable where the capacity was less than 1,000 horsepower, and then only in special forms of gas producers from types of fuel unusually rich in combined nitrogen.

*The Mond Gas Producer.*—The principle that ammonia could be profitably recovered during the gasification of low-grade bituminous coals in gas producers was first demonstrated by Dr. Ludwig Mond, who embodied his researches in the special form of gas producer which bears his name. Since this was done nearly a hundred plants in various parts of the world have been equipped with the Mond gas producer, although all are not equipped to recover ammonia. At least one of these plants has a rated capacity of 30,000 horsepower and consumes more than 300 tons of coal daily, and others are of large size. The gas generated in these producer-gas plants is used for almost every purpose for which power and fuel are needed in quantity.

These statements become significant when to them is added a recent announcement by the manufacturers of the Mond gas producers, who have so fully demonstrated the use and value of producer gas for power and fuel. In this announcement they report the facts that they have perfected a type of gas-producer and ammonia-recovery apparatus for gasifying peat and that after several years of experimentation, they now have in operation three fully equipped commercial plants which successfully use for fuel peat containing as high as 60 to 70 per cent of water. The report further states that from the gas obtained in these plants sulphate of ammonia has been obtained in quantities ranging from 70 pounds per ton of theoretically dried peat gasified, when the peat had 1 per cent of combined nitrogen, to more than 200 pounds per ton when the nitrogen content was 2.3 per cent. The report continues with the statement that, when such plants are carefully managed—

“So great are the profits obtainable that it is often possible, while taking no credit whatever for the value of the power gas, to obtain as much as 100 per cent profit from sulphate of ammonia alone, after making proper allowance for the cost of digging the peat, bringing it to the plant, and for labor, stores, capital, shares, etc. Indeed, with peats comparatively poor in nitrogen, it is possible in many cases to produce the gas for nothing, the cost of power being then merely that of operating the gas engines, together with capital charges on the same.”

Although these claims may be somewhat optimistic, it is clear that if each ton of theoretically dry peat gasified yields from 75,000 to 90,000 cubic feet of producer gas, the calorific value of which is from 125 to 135 British thermal units per cubic foot, and also gives 200 pounds of sulphate of ammonia as a by-product, the operation of a plant consuming 10 tons of dry fuel per day would produce a ton of the ammonia salt. The price of sulphate of ammonia has for some years remained very uniform at about \$60 per ton in spite of enormously increased production.

That this process is of practical application in the United States and should be investigated carefully by owners of peat lands is further indicated



by the composition of some American peats. These often are rich in combined nitrogen, as is shown by the following: In a series of 20 analyses of samples of Ohio peats, made by the Bureau of Mines, the average content of combined nitrogen, on the water-free basis, was 2.79 per cent, the highest of the series having 3.39 per cent and the lowest 2.22 per cent. It must be kept in mind, however, that there are many types of peat in this country and that some of them contain much less nitrogen than the average given for the Ohio peat analyses.

*Peat as a Fuel in Large Power Plants.*—The possibility of using peat as fuel in large power plants is much increased by the fact that it can be used with as much as 60 to 70 per cent moisture in the Mond producers, and the assurance that this has been done on a large commercial scale is a very important advance. Hitherto it has been stated that the difficulty of drying peat so that it became efficient fuel made its use in large plants so hazardous that few have been willing to try it. If it can be used in the gas producer when it contains as much as 60 per cent water it will be possible, if necessity should arise, to dig the raw material even during the winter, and by pressure alone to remove nearly enough water to make the material thus obtained serviceable in the gas producer.

The process described is practically very similar to that of the German chemists, Frank and Caro, and from these inventors comes also the positive statement of the entire success of their plans which have been embodied in one or more large commercial electric power stations in Germany, located on peat bogs of large area.

It seems probable, therefore, that within a short time, if these commercial operations are as successful as described, peat will be more widely used as fuel than ever before, and that it may come into use in many parts of the United States where swamps and bogs are common.

*Powdered Peat at Back, Sweden.*—During the year 1910 reports have been published from conservative and reliable sources that at Back, Sweden, the long-continued work of Lieut. H. Ekelund has at last culminated in the successful commercial production of dry powdered peat for fuel, and in a practical method of using the material for generating heat for making steam.

The method used to prepare the raw wet peat is radically different from that used in the United States to produce peat fertilizer filler, a very similar product. At Back the peat is dug by a mechanical excavator, designed especially for digging peat. The peat is macerated and the wet pulp is spread on the bog surface and partly dried. When dry enough to store without deterioration—that is, when it contains less than about 60 per cent of water—the powdered peat is gathered and stored under cover, enough being thus prepared during the short northern summer of Sweden to supply the rest of the plant with raw material for the entire year. This stored peat, as needed, is ground into powder, screened to give uniform size to the dust, and dried by artificial heat in a type of drier invented for the purpose until it contains about 15 per cent of moisture. It is then packed in waterproof bags for storage or shipment.

The statement has been published, as the result of carefully supervised tests, that peat powder made by this method from pure peat, and burned in the way developed by the inventor, is nearly or quite as efficient a fuel as equal weights of good English coal, and that it can be made in the inland districts of Sweden at less than the cost of coal at the same places.

Aside from the value of the type of peat fuel thus produced, the mechanical devices which have been developed at Back for digging, spreading, and handling peat fuel on a large scale, both in the field and in the factory, seem so successful that they may be noted as marking real progress in the difficult matter of insuring large and certain production of peat fuel for any purpose for which it may be required. This peat-powder factory is equipped to produce 10,000 metric tons per year of powdered fuel containing 15 per cent of moisture, and the actual cost of production, ascertained from tests reported to the Swedish Government and including all charges for interest, operation, etc., is said to be about \$2.30 per ton as a high estimate.



As powdered coal has been used successfully in a number of important industries for many years and as powdered peat is now being produced in the United States for fertilizer uses, the work of Ekelund is of special interest. If powdered peat can replace powdered coal in the industries in which the latter material is used for fuel, there are, without doubt, many localities in the United States where the industries using powdered fuel could be established, to which coal could not be cheaply transported. This, as well as several uses to which peat powder is put or can be put in this country, make a thorough investigation of Ekelund's method of producing it of special interest and importance.

*Cost of Labor.*—It has been very generally said by those who have studied the methods of making peat fuel in use in Europe that these could not be introduced into the United States because labor is so much more costly here than in the peat-producing countries of Europe. This statement has been so often reiterated that it has almost the standing of an economic law. Its force has been so felt that it may be said that because of it no really well directed efforts have been made in the United States to manufacture machine peat, which is the form of peat fuel successfully made in Europe, by closely following the procedure in vogue and thoroughly proved abroad. Instead of testing these methods, a total of hundreds of thousands of dollars has been spent in trying "new and improved" plans and devices for making peat fuel, with only failure in the end.

It has been the contention of the writer that until the facts were determined by actual tests, under favorable conditions of equipment, location, supervision, and capitalization, the question of successful introduction of the best foreign machinery and methods was, at least, an open one. This position was amply confirmed by the success of the demonstration peat-fuel plant\* of the Canada department of mines located near Alfred, Ontario, about 45 miles from Ottawa. This was equipped with Swedish machinery of standard make, the reliability of which had been fully proved by commercial use in many parts of Europe.

The operations involved in producing a good quality of air-dried machine peat were carried on exactly as in Europe, including digging the raw peat and turning and gathering the dried product, by hand labor. The other processes were mechanical, the entire plant being driven by a single portable steam engine located at the working opening in their bog and using refuse peat and wood as fuel. The laborers were paid wages equal to those paid in the United States for similar work, and the cost of production per ton of salable material, based on the operation of the plant an entire season of 140 days, at the rate of production attained in 1910, the first year it was operated, was as follows:

#### COST OF AIR-DRIED MACHINE PEAT AT ALFRED, CANADA.

Cost per ton, on the field.....	\$1.40
Cost per ton, stored in shed.....	1.65
Cost per ton, loaded in cars.....	1.65
Cost per ton, in stack.....	1.70

These cost figures are official; they include interest on capital, amortization, oil, and repair charges, and are derived from the actual production of 1,600 tons of salable material. The actual cost of production for fuel, labor, etc., was about \$1 per ton. The output of the plant could have been doubled by operating night and day, and could also have been increased by lengthening the season of operation. On the assumption that 2 tons of this air-dried machine peat are only equal to 1 ton of anthracite—which is a very low valuation, as peat fuel frequently has a fuel value exceeding 9,000 British thermal units per pound and anthracite seldom has more than 13,500 British thermal units per pound—it would still be possible to produce peat fuel and sell it at a profit, while giving full heating value, in those parts of the United

\*Bull. Canada Dept. Mines, Mines Branch, No. 4, 2d Ed., Ottawa, Canada, 1910.



States where peat is abundant, if it can be made at the prices reported from this Canadian fuel plant.

*Conclusions.*—The conclusion to be drawn from this consideration of the facts presented seems plain: It is possible to make a commercial success of the production of machine peat under economic conditions similar to those existing in many parts of the United States by using European machinery and methods. To insure this success, however, the equipment must be carefully selected, sufficient capital fully to equip and support the enterprise must be supplied, and it must be managed by a man thoroughly familiar by training and experience with this work.

If the successful season's work of the Canadian demonstration plant is repeated in following years, its success for 1910 will be considered the most important event in peat-fuel production achieved up to that time in North America. It should be understood, however, that, while the success of this plant seemingly points to success in the adoption of the same methods and similar machinery in the United States, it does not preclude making changes in either machinery or methods which will fit them more exactly to economic conditions existing here after machinery or methods have been given a trial and found insufficient.

The point demonstrated, however, seems clear, that peat fuel of good efficiency can be made at a profit without adopting other methods or machinery. Hand digging, for example, although employed at Alfred, is not essentially a part of the success of the operations there; in fact, one of the changes contemplated for the immediate future in the equipment of the plant is the substitution of a mechanical excavator to dig the raw peat from the bog.

*Peat-digging Machinery.*—In those parts of Europe where peat fuel is made in largest quantities for power production, machinery for digging peat is being developed and tested in commercial plants. During the season of 1910 several patterns of mechanical excavators were given thorough tests at plants working under commercial conditions and were pronounced satisfactory; and these can now be purchased. The essentials of such a mechanical digger are that it shall be of light but very strong build, and that it shall leave the walls of the openings made in the peat with such a slope that breaking down and slumping into the holes is avoided as much as possible, as this makes future work difficult or impossible. It is necessary, also, that the capacity of the digging machinery shall be large and that the cost of operation in power and labor shall be low. One such machine was reported at the end of 1910 to have dug the equivalent of 8 tons of salable peat fuel per hour, requiring but one man more than the number usually needed to operate the engine and machinery used where hand digging is in use; eight or ten men were displaced by this device.

The appearance of such a machine in any country must be considered a distinct advance, and one that may make easier and simpler the development of the peat resources of the United States because it removes the bugbear of "too much hand labor."

For several years past in Oldenburg, Germany, a mechanical peat-fuel plant has been in operation. This consists of simple but effective digging, pulping, and spreading machinery, the engine to run it all being mounted on a platform mounted on trucks which run on rails placed on the surface of the bog. A gasoline engine furnishes the power for all of the machinery and moves the plant forward or backward on the tramway; and but a single man is needed to operate the entire plant. The peat is laid out on the cleared surface of the bog in the form of bricks on the opposite side of the tramway from that on which the digging is done, and is thereafter turned and gathered by hand.

Two types of automatic, self-propelling mechanical plants were developed in North America in 1910, one in the United States and one in Canada. These differed from the German model in many details, but especially in the fact that no rails were needed to support them on the bog surface. Both of the new plants were equipped with a form of movable platform sometimes used on agricultural machinery under the name "caterpillar tracking." These

platforms are endless belts of narrow planks linked together by strong chains and passing over the broad supporting wheels, so that they are moved forward with the machine and at the same time give it adequate support on the soft substratum of the peat bog.

In these combined plants the peat is dug, elevated, macerated, spread, and marked automatically, and the amount of manual labor and the number of men employed as compared with older plants is greatly decreased. Either electricity, steam, or gasoline motors may be used in such plants, and but one or two men are needed to operate them, although their output may be very large.

These devices are still in the process of development, but their performance during 1910 was sufficiently good to show that they promise real advancement in the production of peat fuel for all purposes when they are perfected.

The only peat-fuel plant erected in the United States in 1910 was that of the Peat Products Co., at Lakeville, Ind. This plant, however, was not fully equipped until after the end of the year. It is described as a plant in which the peat is dug by the use of a centrifugal pump, pumped to storage bins, and after some of the water has drained away, dried in a special drier heated by exhaust steam and stack gases. When dry, the peat is reduced to powder, conveyed to a briquetting press, and compressed into compact briquets. The machinery used is all of novel design and is automatic in action.

### STONE.†

The production of building stone in North Carolina during the past twelve years showed a decided increase up to and through the year 1907, when the largest production yet reported was made. During the year 1908, however, there was a falling off as compared with 1907, when the value of the stone quarried in the State amounted to \$824,927. In 1909 the value of the stone quarried amounted to \$850,807, and during 1910 there was a decided increase as compared with the two previous years when the stone quarried amounted to \$920,027.

There is given in the table below the value of the production of various stones produced in North Carolina for the years 1900 to 1910, inclusive.

PRODUCTION OF BUILDING STONES IN NORTH CAROLINA, 1900-1910.

Year	Granite	Sandstone	Marble and Limestone	Total Value
	<i>Value</i>	<i>Value</i>	<i>Value</i>	
1900.....	\$ 257,962	\$ 27,210	\$ .....*	\$ 285,172
1901.....	264,906	11,682	8,357	284,945
1902.....	338,749	4,825	23,153	366,727
1903.....	334,357	600	25,365	360,322
1904.....	292,439	250	19,887	312,576
1905.....	564,425	4,482	29,015	597,922
1906.....	778,819	3,431	72,051	854,301
1907.....	903,476	4,105	46,338	956,919
1908.....	771,522	**	53,405	824,927
1909.....	743,876	-----	103,931	850,807
1910.....	837,742	**	77,585	920,027

\*Statistics not collected for 1900.

\*\*Included in total production.

†See Bull. 2 of the N. C. Geol. and Econ. Survey.



## GRANITE.

## PRODUCTION.

1908.—The production of granite during the year 1908 amounted to \$764,272, a decrease of \$142,204 when compared with the 1907 production of \$906,476.

1909.—The production of granite during 1909 was valued at \$743,876, a decrease of \$20,396 when compared with the 1908 production of \$764,272.

1910.—The production of 1910 was valued at \$839,742, an increase of \$95,866 when compared with the 1909 production of \$743,876. The number of operators quarrying granite during 1910 was 34. These operators worked 35 quarries in the following 15 counties, which are given in the order of the importance of their production: Rowan, Surry, Warren, Rockingham, Buncombe, Polk, Vance, Mecklenburg, Wake, Anson, Davie, Gaston, McDowell, Wilson, and Henderson.

Not quite a third of the granite produced during 1910 was used for building and monumental purposes, amounting to \$268,372. There is given in the following table the use and value of granite quarried from 1906 to 1910, inclusive.

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1906-1910.

Uses	1906	1907	1908	1909	1910
Building and monumental purposes.....	\$ 375,074	\$ 432,913	\$ 330,836	\$ 249,511	\$ 268,372
Paving blocks.....	33,428	65,379	122,488	214,508	164,265
Curbing and flagging.....	138,090	66,967	107,328	99,386	113,778
Crushed stone for road making, railroad ballast, etc.....	228,429	336,657	153,749	78,605	291,327
Other purposes.....	3,798	4,560	49,871*	101,866*	2,000
Total value.....	\$ 778,819	\$ 906,476	\$ 764,272	\$ 743,876	\$ 839,742

\*Principally for concrete.

The next table gives the value of the granite produced from 1897 to 1910, inclusive, which shows very strikingly the remarkable growth of this industry in North Carolina. The greatest production yet made was during the year 1907 and during the years 1908 and 1909 there was a considerable decrease, but in 1910 the figures again began to go up.

PRODUCTION OF GRANITE IN NORTH CAROLINA, 1897 TO 1910.

Year	Value	Year	Value
1897.....	\$ 59,236	1904.....	\$ 292,439
1898.....	79,969	1905.....	564,425
1899.....	225,544	1906.....	778,819
1900.....	257,962	1907.....	906,476
1901.....	264,906	1908.....	764,272
1902.....	338,749	1909.....	743,376
1903.....	334,357	1910.....	839,742

## SANDSTONE.

## PRODUCTION.

For the past three years there has been but little change in the sandstone industry in North Carolina. But one quarry has been worked and for this reason we are unable to give figures relating to the production. The production of sandstone is given in the table giving the total production of building stones in North Carolina.

## MARBLE AND OTHER FORMS OF LIMESTONE.

## MARBLE.

The Geological Survey has received during the past few years a number of specimens of marble from various localities in the western part of the State, some of which show considerable promise of developing into commercial deposits. Mr. Arthur Keith, of the U. S. Geological Survey, in the Nantahala Folio No. 143 of the Geological Atlas of the United States, gives a description of some of the marbles of the Nantahala Area, which is given below:

One of the most important rocks having commercial value in this district is marble. It covers many square miles, as represented on the geologic map, and it outcrops along two principal lines. The main one begins on Nantahala River below Hewitts and extends southwestward to and down Valley River a distance of over 25 miles. A shorter and parallel band extends from the head of Peachtree Creek nearly 10 miles southwestward and up Little Brasstown Creek. The latter of these two belts terminates a few miles west of this quadrangle, but the principal belt extends through Cherokee County and many miles into Georgia, being nearly continuous with the marble belt of that State. Through most of its extent the marble is tilted up at a considerable angle and its outcrop forms only a narrow band. On Peachtree Creek, however, and on Valley River between Marble and Valletown the dips are less and the marble spreads out over considerable areas.

*Color and Grain.*—The marble has two principal colors—white and blue. Both of these are seen throughout the range of the formation, but the blue and bluish colors predominate toward the northeast. Very little of the blue stone has a uniform color; usually it is more or less banded or mottled with white. Where the marble beds are on edge or have a high dip the banding of color is more regular than in other places. There is also a banding due to lines of foreign minerals. This is best seen in the quarry a mile northeast of Andrews and is caused by lines of mica flakes. An exceptional color, and one of great beauty, is the rose pink which is seen just northeast of Red Marble Gap. This merges into white beds, and the amount of the pink stone is limited. The distribution of the colors of the marble can not be given in detail, on account of the few natural exposures and the few quarries which have been started. What is probably the largest body of white marble is in the bottom lands of Valley River below Andrews.

The grain of the marble is in all cases uniform and fine. It does not appear to be changed by the transition from one color band to another. Probably the grain of the rock is a little coarser toward the southwest, but the difference is very slight. Where the rock is composed of pure carbonates there is practically no tendency to part along the original sedimentary layers. Thin layers of micaceous minerals cause a slight schistosity where they are developed. This is not sufficient to affect the strength of the



quarrying of the rock. Some of the upper layers next to the Andrews schist have more of the secondary minerals where the transition takes place between the two formations. This does not affect the marble as a whole. Northeast of Red Marble Gap similar transitions are seen at the base of the marble, and there is considerable development of micaceous minerals. This causes a decided schistosity, which, however, is limited to the few feet of interbedded marbles and slates. With these exceptions the marble is a uniform and massive rock, and blocks which have been sawed across the bedding planes show no indications of parting in those planes.

*Composition.*—The chief variations in the composition of the marble are in the proportions of the carbonates of lime and magnesia. These have no particular bearing upon the value of the rock, as they do not affect its strength, durability, or density. The lime varies from 53 to 32 per cent and the magnesia from 2 to 20 per cent. Other variations are due to the varying amount of the included minerals. These are talc, muscovite, biotite, tremolite, ottrelite, garnet, pyrite, and quartz. The amount of quartz varies. From 1 to 2 per cent is present in practically all the beds. The micas are practically confined to the uppermost and lowest layers of the formation. The tremolite and talc are concentrated into lenticular deposits and do not affect the workings of the marble as a whole. Certain other layers contain tremolite crystals, as seen in the quarry on Marble Creek at the border of the quadrangle. The pyrite and garnet are found at a number of places in the lower layers of the formation, but are comparatively rare. In short, the minerals which would injure the working and appearance of the stone are very slight in amount and easily avoided.

During the metamorphism of the marble the carbonate crystals were formed interlocking with one another. This has produced a rock of great density and closeness of texture. Tests of marble from Hewitts, on Nantahala River, show that it is not liable to be acted upon by frost or solution. Four samples of rock from this locality gave an average crushing strength of about 11,000 pounds per square inch.

*Thickness.*—The total thickness of the marble beds is about 500 feet. The only obtainable measurements are in the southwestern end of the main marble belt. In the broader areas underlain by the formation the different layers have been repeated by folding. Since the beds do not part along the original sedimentary planes, the effect of the thickening has been to increase the marble available for quarrying. Northeast of Valletown the marble is bounded for the most part by fault planes; thus it varies much in thickness, and in places is entirely absent. Along Nantahala River the entire marble bed is present in many places, but appears to have been somewhat squeezed and thinned during the process of folding. Good measurements of its thickness in the vicinity of Hewitts give scarcely more than 150 feet. Below Hewitts the bed is soon cut off by a fault and does not appear toward the northeast. In the quarry on Marble Creek, where the marble passes into the Murphy quadrangle on the west, the following section is exposed: At the bottom are several feet of white marble with tremolite crystals; above this are 50 feet of pure white marble, 40 feet of blue marble, and 30 feet of white marble. After a small interval in which there are no exposures the ottrelite-bearing Andrews schist outcrops. Thus only a small part of the normal total thickness is exposed.

*Joints.*—The marble when pure is very resistant to weathering agencies. In course of time its upper parts have been dissolved away, but the remaining rock is perfectly fresh and hard. This general condition is affected somewhat by the lines of micaceous minerals near the top and bottom of the formation, down which weathering has penetrated to considerable depths. It is also seriously affected by joint planes and other planes along which slight movements have taken place. These are particularly conspicuous in some of the sections along Nantahala River, and the action of weather has broken up the marbles and adjoining quartzites into blocks of varying size. These were not caused during the formation of the fault, but seem to be due



to later disturbances along the same lines of weakness. Somewhat similar phenomena are seen where the marble belt contracts again toward the southwest. In that situation too there is a fault plane within a short distance toward the southeast. The exposures of the marble are very poor in that area, but the quartzites are considerably jointed, and probably the marbles are affected in the same way. These joints do not appear when the fresh rock is taken out of the quarries, but are developed by exposure to weather. No noticeable amount of motion has taken place along these planes and they represent merely a tendency to separate. Of slightly different character are various seams along which motion has taken place. These are usually accompanied by a slight development of the silicates in thin films which are frequently striated in the direction of the motion. In places these seams disconnect the portions of the marble, even in the solid rock, and cause it to break up after short exposure. They are not present in all the marble, by any means, and the amount of good material seems to be very large. Where the rock has been extensively quarried in regions farther southwest the character of the stone is not greatly different and the geologic surroundings are substantially the same. It is therefore probable that good material will be abundant in this region.

*Accessibility.*—While the marble does not often outcrop in this region, there are numberless quarry sites available. The surface of the marble is covered by 6 or 8 feet of soil and gravel along the flood planes of the different streams, and in other positions by a slightly greater amount of wash from the various formations. This is true not only of the entire Valley River basin, but also of the Peachtree and Brasstown areas. In the latter situation, as well as in the bottom lands for large areas below Andrews, the presence of the marble has been proved in scores of places, although it scarcely outcrops at all. Northeast of Red Marble Gap even this thin covering is much lessened and natural outcrops of the marble are frequent. The Murphy branch of the Southern Railway follows closely along the principal marble belt. In fact, the low ground which the railroad follows is, with the exception of 4 or 5 miles, caused directly by the presence of the marble. Thus delivery of the quarried material to the transportation lines is exceptionally easy. Southwest of Marble the formation has an average dip of 50° to 60°, so that long-continued quarrying would entail deep cutting and hoisting. In the same degree the disposal of water would be a question to be considered. The surface of the marble in those localities is seldom more than 60 feet above Valley River, and much less above the minor creeks. Considerable pumping would therefore be necessary in quarries of any depth. Northeast of Marble the situation is much the same, except that the rock is seldom more than a few feet above drainage level. In all these areas, therefore, drainage and disposal of the waste material are of importance. Between Marble and Valletown the dips vary much, but on the average are small. Consequently openings on the marble could readily be extended over the surface and the stone taken out more easily. Northeast of Red Marble Gap the topography is very rugged and presents great natural advantages so far as drainage and disposal of waste are concerned.

The North Carolina Mining and Tale Company are developing their marble deposit at Hewitts. Some splendid blocks of this marble have been taken out and are on exhibition at the Appalachian Exposition, Knoxville, Tennessee. The main obstacle to the development of these marble deposits is high freight rates.

#### LIMESTONE.

The production of limestone in North Carolina is used for four purposes: for burning into lime, for road building, for a fertilizer, and for chicken grit.



The Yadkin Lime Company of Winston-Salem has been organized to develop the old lime rock near Siloam, in Yadkin County. They have installed crushers and other machinery for grinding the limestone into agricultural lime. The company also hopes to make lime for building purposes.

The King Lime Fertilizer Company of Brevard, Transylvania County, has been organized to develop a quarry. The properties to be developed are what is known as the Old Gash Lime Kilns and the Sims Kilns and other lime properties in that section. The proposed developing includes about three miles of track connecting the properties with the railroad, of six perpetual coal burning lime kilns, and one or more huge rock crushers. The company will furnish ground lime for fertilizer, and burned lime for fertilizer, building and other purposes.

Mr. C. H. Foy, of Kinston, has located a deposit of shell at his lumber camp in Jones County, at Foy's Crossing. An analysis of this shell by the North Carolina Agricultural Station gave 54 per cent lime; and an analysis by the Virginia Agricultural Station showed 60 per cent lime. There seems to be a quantity of this lime in this section, and is said to contribute a great fertility to crops, especially for alfalfa.

A similar deposit in Craven County, near New Bern, is being worked by the Carolina Coast Lime Company and put on the market as a chicken grit and fertilizer.

#### PRODUCTION.

The production of marble was obtained from one quarry and can not be given separately. The production of lime and limestone was obtained from six counties, which are given in the order of the importance of their production: Henderson, New Hanover, Craven, Beaufort, Jones, and Transylvania.

There is given in the following table the value of the production of limestone from 1901 to 1910, inclusive.

PRODUCTION OF MARBLE AND OTHER FORMS  
OF LIMESTONE, 1901-1910.

Year	Value
1901.....	\$ 8,357
1902.....	23,153
1903.....	25,365
1904.....	19,887
1905.....	29,015
1906.....	72,051
1907.....	46,338
1908.....	53,405
1909.....	106,931
1910.....	77,585

**SAND AND GRAVEL.**

The only figures given under this head are those which could be obtained of sand and gravel used by molders or by railroads. This does not represent all the sand used for molding, as a good deal is used by foundrymen, obtained nearby their places of business and of which no special record is kept as to the quantity obtained, or its cost.

A great deal of sand is used in the manufacture of mortar for brick and stone work which is not taken into account. Also a great deal of sand is used in the manufacture of plaster of which no account is taken. Another use which is increasing rapidly in North Carolina is as sand and crushed stone in the manufacture of concrete.

There are undoubtedly in Eastern North Carolina certain sands of sufficient purity to be used in the manufacture of glass, but to date no manufacturing establishment has been organized for such an industry.

**PRODUCTION.**

In the following table there is given the production of sand and gravel in North Carolina from 1905, when these figures were first obtained, to 1910 inclusive.

PRODUCTION OF SAND AND GRAVEL  
IN NORTH CAROLINA, 1905-1910.

Year	Value
1905.....	\$ 547
1906.....	9,191
1907.....	2,191
1908.....	2,070
1909.....	13,358
1910.....	12,403

It will be seen from the above table that there has been a pretty steady increase in this industry, and, when the advantages of certain of the North Carolina sands are realized, new industries will undoubtedly come up which will utilize these sands and greatly increase the annual production.

**SAND-LIME BRICK.**

In the report for 1905 there was given a rather complete description of sand-lime brick and their manufacture. The demand for these artificial bricks is increasing and the uses to which they are put are numerous. It is claimed by the manufacturers that the bricks are suitable for use in superstructures and foundations, and for all underground work, especially for sewers; that they improve with age, have great crushing strength; are low in porosity; are poor conductors of heat, and are unaffected by acids. It is also claimed that they are sanitary,



and that they will not disintegrate under extreme climatic changes. On account of their uniform size, shape, and color, it is said that they can be economically laid and be made to produce a like face on both sides of an 8-inch wall. The bricks can be tinted any shade of color desired. There are good possibilities for the development of this industry in Eastern North Carolina, with its large amount of available sand, and a statement concerning the present status of this industry in Germany, where the process of making sand-lime bricks originated, may be of interest, and the following report by Consul-General Robert P. Skinner, Hamburg, on Sand-Lime Bricks in Germany is quoted from the Advance Chapter from Mineral Resources for 1909 on the "Production of Sand-Lime Brick":

The manufacturer of sand-lime bricks (called "kalksandsteine") in Germany has assumed large proportions in the last few years, and the great improvements effected in processes of manufacture amply justify the adoption of this building material in the United States. From 1897 to 1902 alone 80 plants were established in Germany for the production of these bricks, and there are now said to be 280 in operation. Hamburg firms producing kalksandsteine are satisfied with the business results.

Ordinary sand-lime bricks sell at an average price of 2 marks (\$0.476) less per 1,000 than clay bricks. The cost of production is said to be 9 to 12 marks (\$2.142 to \$2.856) per 1,000, but it is difficult to generalize on this, as no two localities are situated alike as to raw materials. In 1902 the German Reichstag purchased 9,000,000 bricks of this kind, made by the Schwartz process, for army buildings at a saving of \$20,000 over clay bricks.

*Original Method of Manufacture.*—The elementary facts in the brick business are that clay does not exist everywhere, whereas sand is found almost everywhere and can be used at a lower cost. The processes of manufacturing sand-lime brick are numerous, some being protected by patents. The original method of manufacture was as follows:

Fat lime slaked to a thick milk is mixed with six to twelve times its own quantity of coarse sand and then carefully kneaded either by hand or in a mixing machine. Bricks are then formed in an ordinary clay press, and after twenty-four hours, being then slightly dry, are stacked together and assume sufficient hardness after three to four weeks. The hardening process is accelerated by dipping the slightly dry bricks in a very thin solution of silicate of potash.

Thus a very cheap material can be produced for agricultural buildings where lime and good sand are available. The bricks are frost proof and rather compact, and no extensive machinery is required. Sand-lime bricks produced upon an industrial scale are the pressed product of a complete mixture of lime and sand hardened (molded?) under steam pressure of an average minimum compressive strength of 140 kilos per square centimeter (308.64 pounds per 0.155 square inch). This mortar contains 5 to 8 per cent of lime, and upon being pressed into bricks—which are then exposed to a steam pressure, usually under 72 (7.2) atmospheres during eight to ten hours—the bricks can be used at once.

*Increasing Success of this Type.*—The foregoing process is based upon the discovery, in 1880, of Doctor Michaelisin, that salicylic acid can be decomposed, that is to say, can be caused to form hydrated silicate of lime by chemical combination with lime from hydrate of lime only in a very high temperature and in the presence of steam. This high-pressure process has been developed in Germany since 1898, and it is believed that from eight



hundred million to one thousand million bricks of this kind are being manufactured annually. Bricks of this kind are rivaling clay bricks with increasing success, their adoption being furthered by the facts (1) that an extraordinary small quantity of lime is necessary, since the poorest mortar requires more sand than lime; (2) that sand can be found almost everywhere; (3) that the time required to manufacture is short and the general expenses are low; (4) that the bricks can be manufactured at all seasons of the year.

Fat lime is used ordinarily in the manufacture of these bricks and hydraulic lime very seldom. Dolomitic lime, which slakes slowly, is not available. Any kind of quartz sand which is free from clay and not too coarse can be used.

*Variations in Component Elements.*—The various processes are distinguished from each other by the method of treating the lime. In some the lime is completely slaked to powder or paste before being mixed with the sand, this being the ordinary hydrate process. Elsewhere the lime is ground to powder (quicklime powder), then mixed with sand, and then slaked. The hardening of the bricks is always done in the same manner—in a hardening boiler. According to the first, or hydrate process, the mixed material remains at first amorphous, and then gradually becomes crystalline; whereas in the quicklime process the mixture assumes a crystalline form immediately, which is said to be why the bricks possess a greater solidity from the beginning. However, it is alleged that the quicklime process requires a larger dose of lime, and that the completed bricks are too dense, thus absorbing less water and allowing the passage of less air.

According to Burchartz, there is no material difference between the several kinds of sand-lime bricks as regards density and water absorption, and all kinds of sand-lime bricks increase in compactness within certain limits.

In the pure hydrate process the lime is slaked to powder in a slaking drum or hardening boiler, after having been ground finely. In the mixed processes it is slaked in drums with part of the sand and then, or perhaps after having been stored in silos, it is mixed, with the rest of the sand. In the quicklime process ground-burnt lime is mixed with the entire quantity of sand, water being added steadily to the mixture, which is then pressed, either after having been stored in silos or without previous storing.

Presses of various kinds are in use which have a daily capacity of about 24,000 bricks, which are perfect in shape. Larries loaded with 900 bricks are moved into cylindrical hardening boilers, which are about 2 meters (6.56 feet) wide and 6.25 meters (20.50 feet) long, in which they remain about nine hours under a steam pressure of 8 atmospheres.

*Tests for Strength, Etc.*—In 255 tests the compressive strength varied greatly, the average, however, being 153 kilos per square centimeter (337.30 pounds per 0.155 square inch), which is the tenacity required in a brick of good quality.

Deviations from the average are less than in the clay brick, a result of the greater symmetry of the sand-lime brick in shape and structure. The loss of strength through the absorption of water averages 14 per cent, and from the effect of frost 17 per cent. The average absorption of water amounted to 14.9 per cent weight and 26.3 per cent volume, percentages also less in the case of sand-lime bricks than with clay bricks. All bricks tested proved to be frost proof. In fire tests and in practical experience these bricks have shown the same properties as clay bricks in regard to the influence of fire and water used in extinguishing it.

Fireplaces, factory chimneys, ring ovens, etc., have been constructed with sand-lime bricks with good results. The adhesive property of the mortar on the bricks has been tested, by using the same kinds of mortar on sand-lime and clay bricks, the results being generally in favor of the former type of brick. The weight of structures made from this material is but slightly greater than those built of clay, and according to an order issued in 1907, no greater weight may be estimated in statistical calculations than was ascertained in the use of clay bricks.



Because of their regular form and uniform dimensions, these bricks can be laid more easily, and can also more readily be cut. This regularity of form and their trim appearance has led to a frequent use of sand-lime bricks as facing stones, it being also possible to color them.

*Patents for Special Types.*—German patents 138,935 and 151,945 protect the manufacture of non-conducting bricks which are made of a mixture of sand, lime, and fuller's earth. After the steaming, bricks of this kind can be burned, and before being burned may be soaked with "wasserglas" (silicate of potassium or sodium).

German patent 158,615 protects a process for the elimination of the objection that the color of sand-lime bricks changes in rainy weather. According to this process the bricks are covered with a glaze while under steam pressure, which glaze, upon being burned with the bricks, dissolves and combines with the lime silicate in the brick. Various colored glazes may be applied. There are quite a number of other German patents relating to this industry, or branches thereof, full copies of which can probably be obtained if inquirers care to pay the fees.

#### PRODUCTION.

The following table gives the production of sand-lime brick in North Carolina from the year 1904 to 1910, inclusive. For the past three years there has been a steady decline in the number produced.

PRODUCTION OF SAND-LIME BRICK IN NORTH CAROLINA, 1904-1910.

Year	Common Brick		Front Brick		Total Value
	Number	Value	Number	Value	
1904.....	1,800,000	\$ 17,500	.....	\$.....	\$ 17,500
1905.....	3,185,000	20,953	660,000	8,150	29,103
1906.....	3,147,000	22,225	750,000	10,750	32,975
1907.....	4,038,000	29,458	755,000	9,350	38,808
1908.....	1,450,000	10,500	300,000	3,500	14,000
1909*.....	.....	.....	.....	.....	.....
1910*.....	.....	.....	.....	.....	.....

\*Production given in General Mineral Table under "Miscellaneous" p. 10.

**CLAY.\***

Since the publication of the Report on the Mining Industry for 1907, the total value of the production of clay products has been well up around the million dollar mark, with the largest production made in the year 1909. The bulk of the value of the clay production each year is due to the production of common brick. The number of pressed, fancy, and vitrified brick is yet very small in comparison with what might be produced when the quality of the North Carolina clay is considered and the demand for such brick.

While there has been considerable improvement in the last three years in the method of manufacture of common brick, the result of which has been an increase in the value of common brick per thousand, still much remains to be learned, and it is believed that if a course in ceramics could be given in our colleges that it would open a new field of industry to a great many of our people which would undoubtedly prove very profitable and add to the value of the State by the growth of this industry.

During the summer of 1911 the United States Bureau of Mines had an expert in Western North Carolina making investigations as to the kaolin and feldspar deposits with a view to their utilization in the manufacture of pottery. Abundant supplies of feldspar and quartz can be obtained in Western North Carolina which could be used in such an industry and there would be the additional advantage of being able to grind these by waterpower with which North Carolina is well supplied.

The Geological Survey continues to urge upon the brick producers the necessity for bettering their methods of brick making so that a higher class product can be put out, which will bring a better price.

In the following tables there is given the total production of clay products in North Carolina for the years 1902-1910 inclusive.

VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA FROM 1902 to 1910.

	1902		1903		1904	
	Quantity	Value	Quantity	Value	Quantity	Value
Common brick.....	131,611,700	\$694,827	136,822,900	\$731,802	143,988,850	\$ 795,494
Pressed brick.....	1,233,000	10,625	766,000	8,230	1,510,000	17,375
Vitrified brick.....	600,000	6,000	500,000	5,000	430,000	3,850
Fire brick.....		1,203	407,500	5,250	163,000	2,700
Earthenware.....		658		612		438
Stoneware.....		13,854		13,700		13,462
Sewer pipe, tile, etc .....		72,618		100,989		110,800
	<i>Tons</i>		<i>Tons</i>		<i>Tons</i>	
Kaolin.....	13,322	108,105	8,605	76,000	9,110	76,670
Fire clay.....		215	231	875	202†	761
Total value.....		903,105		942,458		1,021,550

\*See also Bull. 13 of the N. C. Geol. Survey.



## VALUE OF CLAY PRODUCTIONS OF NORTH CAROLINA—CONTINUED.

	1905		1906		1907	
	Quantity	Value	Quantity	Value	Quantity	Value
Common brick.....	153,610,000	\$896,289	166,338,000	\$1,041,078	174,750,000	\$1,150,185
Pressed brick.....	875,000	13,925	385,000	4,410	770,000	7,925
Vitrified brick.....	400,000	3,600	400,000	4,000	150,000	1,500
Fire brick.....	681,000	8,333	401,000	7,180	194,000	3,490
Earthenware.....		387		713		2,382
Stoneware.....		12,932		11,037		7,840
Sewer pipe, tile, etc.....		102,445		113,900		142,000
	<i>Tons</i>		<i>Tons</i>		<i>Tons</i>	
Kaolin.....	10,988	85,622	10,803	90,036	11,035	85,505
Fire clay.....	107†	519	207	322	903†	986
Total value.....		1,124,052		1,272,696		1,401,813

	1908		1909		1910	
	Quantity	Value	Quantity	Value	Quantity	Value
Common brick.....	143,892,000	\$900,611	188,313,000	\$1,140,727	167,966,000	\$1,039,319
Pressed brick.....	300,000	2,700	725,000	9,250	550,000	5,800
Vitrified brick.....	50,000	400				
Fire brick.....	700,000	7,560				
Earthenware.....		775		1,780		1,961
Stoneware.....		12,587		16,929		13,029
Sewer pipe, tile, etc.....		19,335		133,925		163,555
	<i>Tons</i>		<i>Tons</i>		<i>Tons</i>	
Kaolin.....	10,532	85,300	} 12,097	99,174	14,080	119,040
Fire clay.....	2,298	349				
Total value.....		1,029,617		1,401,785		1,342,704

†Including ordinary stoneware clay sold crude.

A review of these tables will show that there has been a steady increase in the value of the clay production up to 1907. There was a slight falling off during 1908, which was made up again in 1909, and a slight decrease in 1910.

These tables probably do not represent the total output of all the clay production of the State for the reason that in some counties there are a few thousand brick made for local purposes regarding which it is extremely difficult, or impossible, to obtain statistics, this being especially true where the brick are not for sale but are used directly by those manufacturing them.

## KAOLIN.

The North Carolina kaolin is obtained from Jackson, Mitchell and Swain counties. There has been a steady increase in the value of the production of kaolin until it has passed the \$100,000 mark. Owing to the fact that there has been but one company producing for a number of years, the figures are not given here but are included in the general table of clay production.

## POTTERY CLAY.

There has been a steady increase in the production of pottery since the year 1907, which reached its maximum in the year 1909 and fell off again in the year 1910.

There is given in the tables below the value of the pottery production for North Carolina, by counties, from the year 1905-1910, inclusive.

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA BY COUNTIES  
FROM 1905 TO 1910, INCLUSIVE

County	1905			1906			1907		
	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total
Buncombe.....	\$ 125	\$2,725	\$2,850	\$ 100	\$1,325	\$1,425	\$ 150	\$2,184	\$ 2,334
Catawba.....		1,930	1,930	135	4,600	4,735	1,392	1,800	3,192
Chatham.....		500	500						
Johnston.....	100	150	250	50	40	90	100		100
Lincoln.....	20	2,059	2,079		1,757	1,757	100	1,100	1,200
Moore.....		100	100	50	100	150			
Randolph.....		790	790	150	1,495	1,645	435	1,496	1,931
Union.....	100	2,400	2,500	178	740	918	165	750	915
Wilkes.....	42	2,278	2,320	30	1,000	1,030	40	510	550
Total.....	387	12,932	13,319	713	11,057	11,770	2,382	7,840	10,222

County	1908			1909			1910		
	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total	Earthen-ware	Stone-ware	Total
Buncombe.....	\$ 75	\$1,876	\$1,945	\$ 270	\$3,260	\$3,530	\$ 630	\$ 400	\$ 1,030
Catawba.....	145	4,460	4,605	1,080	6,980	8,060	821	7,184	8,005
Johnston.....	100	50	150	<i>a</i>					
Lincoln.....		2,142	2,142	355	4,639	4,994	25	1,560	1,585
Montgomery.....		925	925						
Moore.....	60	370	360	<i>b</i>			300	400	700
Randolph.....	255	1,590	1,845	<i>c</i>			120	1,760	1,880
Union.....	140	1,250	1,390	<i>d</i>				300	300
Wilkes.....				75	2,050	2,125	65	1,425	1,490
Total.....	775	12,587	13,362	1,780	16,929	18,709	1,961	13,029	14,990

*a* Included with Buncombe; *b* Included with Wilkes; *c* Included with Lincoln; *d* Included with Wilkes.

The next table shows the total value of the pottery produced in North Carolina from 1900-1910, inclusive.

PRODUCTION OF POTTERY IN NORTH CAROLINA,  
1900-1910.

Year	Value of Pottery
1900.....	\$ 18,863
1901.....	22,495
1902.....	14,512
1903.....	14,312
1904.....	13,900
1905.....	13,319
1906.....	11,770
1907.....	10,222
1908.....	13,362
1909.....	18,709
1910.....	14,990



## FIRE CLAY AND PIPE CLAY.

Under this head are included fire and pipe clays and the products manufactured from them, as fire brick, sewer pipe, drain tile, fancy tile, flue linings, terra cotta, etc.

There is given in the following tables the production of fire clay and pipe clay products from 1901-1910 inclusive which shows a pretty steady increase in the production of these forms of clay product.

## PRODUCTION OF FIRE-CLAY AND PIPE-CLAY PRODUCTS IN NORTH CAROLINA, 1901-1910

Year	Fire Brick		Sewer Pipe, Tile, Etc.	Crude Clay	
	Quantity	Value		Tons	Value
1901.....	55,000	\$ 550	\$ 55,745	-----	\$ 100
1902.....	-----	1,203	72,618	-----	215
1903.....	407,503	5,250	100,989	231	875
1904.....	163,000	2,700	110,809	80	700
1905.....	681,000	8,333	102,445	57	494
1906.....	401,000	7,180	113,900	19	185
1907.....	194,600	3,490	142,000	903	986
1908.....	730,000	7,560	19,335	2,298	349
1909.....	-----	-----	133,925	-----	753
1910.....	-----	-----	163,555	80	40

## BRICK CLAY.

The enormous progress made by the State of North Carolina during the past several years has of course been accompanied by a great deal of building, which has caused an ever increasing demand for building materials. The production of common brick in the State has therefore increased from year to year quite steadily, but would undoubtedly have increased more if the quality of the brick manufactured had been better. In the early part of the year 1911 the Corporation Commission ordered a reduction in the freight rates on brick, which will undoubtedly encourage this industry.

The table below shows the quantity and value of common, pressed, vitrified and fire brick produced in North Carolina since 1907.

## PRODUCTION OF COMMON, PRESSED, VITRIFIED, AND FIRE BRICK IN 1907, 1908, 1909 AND 1910.

Character of Brick	1907		1908		1909		1910	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Common ..	174,750,000	\$1,150,185	143,892,000	\$900,611	188,313,000	\$1,140,727	167,966,000	\$1,039,319
Pressed ....	770,000	7,925	300,000	2,700	-----	-----	550,000	5,800
Vitrified....	150,000	1,500	50,000	400	725,000	9,250	-----	-----
Fire.....	194,000	3,490	700,000	7,560	-----	-----	-----	-----
Totals ...	175,864,000	\$1,163,100	144,942,000	\$911,271	189,038,000	\$1,149,977	168,516,000	\$1,045,119

There is given in the following tables the number and value of the common brick manufactured in North Carolina, by counties, for the years 1908, 1909, and 1910.

NUMBER AND VALUE OF COMMON BRICK MADE IN NORTH CAROLINA  
DURING 1908, BY COUNTIES.

County	Common Brick	Value
Alamance.....	4,820,000	\$ 30,328
Anson.....	1,000,000	7,000
Beaufort.....	1,540,000	9,200
Bertie.....	936,000	6,893
Bladen.....	50,000	400
Buncombe.....	4,396,000	26,019
Burke.....	1,487,000	8,435
Cabarrus.....	5,100,000	35,800
Caldwell.....	900,000	5,400
Camden.....	44,000	375
Catawba.....	2,376,000	11,850
Chatham.....	290,000	1,200
Chowan.....	1,000,000	6,500
Cleveland.....	700,000	4,200
Columbus.....	250,000	2,000
Craven.....	6,791,000	43,241
Cumberland.....	2,500,000	15,058
Davidson.....	300,000	1,650
Duplin.....	80,000	640
Durham.....	3,310,000	21,180
Edgecombe.....	4,014,000	24,781
Forsyth.....	8,500,000	47,200
Gaston.....	4,633,000	27,365
Granville.....	3,350,000	23,150
Greene.....	100,000	800
Guilford.....	6,033,000	33,592
Halifax.....	4,600,000	28,100
Harnett.....	500,000	3,000
Henderson.....	5,250,000	31,125
Iredell.....	2,817,000	18,050
Johnston.....	3,150,000	21,775
Lee.....	500,000	3,000
Lenoir.....	2,050,000	14,650
Lincoln.....	750,000	4,501
McDowell.....	550,000	3,300
Macon.....	130,000	650
Martin.....	1,425,000	8,670
Mecklenburg.....	3,000,000	20,500
Montgomery.....	1,000,000	7,000
Moore.....	650,000	4,350
New Hanover.....	3,200,000	22,500
Orange.....	1,000,000	7,000
Pasquotank.....	1,950,000	12,075
Pender.....	3,500,000	21,000
Perquimans.....	400,000	2,500
Pitt.....	4,031,000	28,165
Randolph.....	1,350,000	8,387
Richmond.....	450,000	2,700
Robeson.....	1,993,000	14,540
Rockingham.....	450,000	2,850
Rowan.....	2,100,000	16,500
Rutherford.....	500,000	3,400
Sampson.....	350,000	2,350
Scotland.....	150,000	1,200
Stanly.....	300,000	2,100
Stokes.....	1,000,000	6,180
Surry.....	2,950,000	15,125
Union.....	6,795,000	40,680
Wake.....	7,440,000	46,689
Wayne.....	6,750,000	40,500
Wilkes.....	1,050,000	5,300
Wilson.....	5,014,000	34,032
Yadkin.....	238,000	1,100
Unknown.....	125,000	750
Totals.....	143,892,000	\$ 900,611



NUMBER AND VALUE OF COMMON BRICK MADE IN NORTH CAROLINA  
DURING 1909, BY COUNTIES.

County	Common Brick No. of Brick	Value
Alamance.....	5,150,000	\$ 33,900
Anson.....	4,421,000	30,283
Beaufort <i>a</i> .....		
Bertie <i>a</i> .....		
Buncombe.....	5,394,000	35,011
Burke.....	3,154,000	16,031
Cabarrus.....	5,025,000	30,150
Caldwell <i>b</i> .....		
Camden <i>b</i> .....		
Catawba.....	2,600,000	13,475
Chatham <i>c</i> .....		
Chowan <i>c</i> .....		
Cleveland.....	2,036,000	11,298
Columbus.....	2,700,000	19,150
Craven.....	6,855,000	37,315
Cumberland.....	4,610,000	26,145
Davidson.....	325,000	2,250
Davie <i>d</i> .....		
Duplin <i>d</i> .....		
Durham.....	6,349,000	40,944
Edgecombe.....	3,843,000	25,362
Forsyth.....	9,437,000	54,648
Gaston.....	2,490,000	13,650
Granville.....	2,850,000	18,475
Guilford.....	10,610,000	60,293
Halifax.....	6,799,000	43,364
Haywood <i>e</i> .....		
Henderson.....	11,200,000	63,610
Iredell.....	3,785,000	26,230
Johnston.....	5,311,000	32,700
Lee <i>e</i> .....		
Lenoir.....	1,583,000	9,244
Lincoln.....	1,150,000	7,725
McDowell <i>f</i> .....		
Martin.....	1,543,000	7,936
Mecklenburg.....	5,885,000	36,561
Montgomery <i>g</i> .....		
Moore <i>g</i> .....		
Nash.....	4,625,000	27,750
New Hanover.....	7,413,000	48,222
Orange <i>h</i> .....		
Pasquotank <i>h</i> .....		
Pender.....	3,350,000	17,700
Perquimans <i>i</i> .....		
Pitt.....	4,425,000	28,512
Randolph.....	2,044,000	12,726
Robeson.....	1,400,000	9,200
Rockingham.....	1,725,000	10,900
Rowan.....	2,550,000	23,800
Rutherford <i>j</i> .....		
Sampson.....	700,000	4,550
Stanly <i>k</i> .....		
Stokes.....	9,941,000	59,676
Surry.....	2,350,000	11,900
Union.....	8,390,000	51,688
Wake.....	10,300,000	58,250
Watauga <i>l</i> .....		
Wayne.....	7,650,000	44,050
Wilkes <i>l</i> .....		
Wilson.....	7,780,000	45,303
Totals.....	188,313,000	\$ 1,140,727

*a* Included with Anson County production; *b* Included with Cabarrus County production; *c* Included with Columbus County production; *d* Included with Davidson County production; *e* Included with Lenoir County production; *f* Included with Martin County production; *g* Included with Nash County production; *h* Included with New Hanover County production; *i* Included with Rockingham County production; *j* Included with Rowan County production; *k* Included with Stokes County production; *l* Included with Wilson County production; *m* Included with Henderson County production.

NUMBER AND VALUE OF COMMON BRICK MADE IN NORTH CAROLINA  
DURING 1910, BY COUNTIES.

County	Common Brick No. of Brick	Value
Alamance.....	5,410,000	\$ 35,520
Anson.....	3,700,000	22,790
Beaufort <i>a</i> .....		
Bertie <i>a</i> .....		
Bladen <i>b</i> .....		
Buncombe <i>b</i> .....	4,079,000	24,270
Burke.....	2,700,000	13,700
Cabarrus <i>c</i> .....	4,035,000	27,865
Caldwell <i>c</i> .....		
Camden <i>c</i> .....		
Catawba.....	2,950,000	16,275
Chatham <i>d</i> .....	2,700,000	18,900
Chowan <i>d</i> .....		
Cleveland <i>e</i> .....	2,250,000	15,100
Columbus <i>e</i> .....		
Craven.....	6,210,000	32,273
Cumberland.....	4,520,000	29,621
Davie <i>f</i> .....	217,000	1,336
Duplin <i>f</i> .....		
Durham.....	5,012,000	39,072
Edgewcombe.....	2,655,000	17,073
Forsyth.....	7,292,000	45,585
Gaston.....	2,344,000	13,402
Granville <i>g</i> .....	1,850,000	10,700
Greene <i>g</i> .....		
Guilford.....	6,458,000	36,148
Halifax.....	5,300,000	33,750
Harnett <i>h</i> .....	900,000	5,200
Haywood <i>h</i> .....		
Henderson.....	6,750,000	37,563
Hertford <i>h</i> .....		
Iredell.....	1,783,000	12,111
Jackson <i>i</i> .....		
Johnston.....	3,255,000	20,758
Lee <i>i</i> .....		
Lenoir <i>i</i> .....	1,578,000	7,536
Lincoln <i>j</i> .....	2,400,000	14,200
McDowell <i>j</i> .....		
Madison <i>k</i> .....	1,047,000	6,127
Martin <i>k</i> .....		
Mecklenburg.....	9,269,000	55,624
Montgomery <i>l</i> .....	1,675,000	10,237
Moore <i>l</i> .....		
Nash <i>m</i> .....	5,750,000	43,000
New Hanover <i>m</i> .....		
Pasquotank <i>n</i> .....	1,660,000	9,050
Pender.....	2,965,000	16,850
Perquimans <i>n</i> .....		
Pitt.....	4,010,000	26,070
Randolph.....	2,300,000	13,950
Robeson.....	2,350,000	16,050
Rockingham <i>o</i> .....		
Rowan <i>o</i> .....	4,225,000	26,200
Rutherford <i>p</i> .....	419,000	2,475
Sampson <i>p</i> .....		
Scotland <i>q</i> .....		
Stanly <i>q</i> .....	1,875,000	12,600
Stokes <i>r</i> .....	10,873,000	67,328
Surry <i>r</i> .....		
Union.....	6,400,000	41,600
Wake.....	10,400,000	60,750
Watauga <i>s</i> .....		
Wayne <i>s</i> .....	9,770,000	59,890
Wilkes <i>t</i> .....		
Wilson <i>t</i> .....	6,150,000	37,850
Yadkin <i>u</i> .....		
Yancey <i>u</i> .....	420,000	2,920
Totals.....	167,966,000	\$ 1,039,319

*a* Included with Anson County production; *b* Included with Buncombe County production; *c* Included with Cabarrus County production; *d* Included with Chowan County production; *e* Included with Cleveland County production; *f* Included with Duplin County production; *g* Included with Granville County production; *h* Included with Harnett County production; *i* Included with Lenoir County production; *j* Included with Lincoln County production; *k* Included with Madison County production; *l* Included with Montgomery County production; *m* Included with Nash County production; *n* Included with Pasquotank County production; *o* Included with Rowan County production; *p* Included with Rutherford County production; *q* Included with Stanly County production; *r* Included with Stokes County production; *s* Included with Wayne County production; *t* Included with Wilson County production; *u* Included with Yancey County production.



## SUMMARY.

In order to show more clearly the value of the mineral production of the State by counties, there is given in the tables below the value of the productions in each county for the years 1907, 1908, 1909, and 1910.

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1907 AND 1908.

County	1907			1908		
	Mineral Production Including Kaolin	Clay Products Except Kaolin	Totals	Mineral Production Including Kaolin	Clay Products Except Kaolin	Totals
Alamance.....	\$-----	\$ 38,325	\$ 38,325	\$-----	\$ 30,328	\$ 30,328
Alexander.....	4,921	-----	4,921	349	-----	349
Alleghany.....	800	-----	800	300	-----	300
Anson.....	3,250	3,500	6,750	-----	7,000	7,000
Ashe.....	2,750	-----	2,750	1,200	-----	1,200
Beaufort.....	-----	14,250	14,250	-----	9,270	9,270
Bertie.....	-----	8,450	8,450	-----	6,893	6,893
Bladen.....	-----	600	600	-----	400	400
Brunswick.....	-----	-----	-----	-----	-----	-----
Buncombe.....	60,944	21,488	82,432	41,446	28,579	70,025
Burke.....	7,636	7,000	14,636	3,994	8,435	12,429
Cabarrus.....	1,522	37,560	39,082	12,275	35,800	48,075
Caldwell.....	-----	14,275	14,275	-----	5,400	5,400
Camden.....	-----	-----	-----	-----	375	375
Carteret.....	-----	-----	-----	-----	-----	-----
Caswell.....	-----	-----	-----	-----	-----	-----
Catawba.....	6,455	22,617	29,072	2,570	16,673	19,243
Chatham.....	1,886	8,500	10,386	2,230	1,200	3,430
Cherokee.....	1,664	-----	1,664	8,175	-----	8,175
Chowan.....	-----	10,000	10,000	-----	6,500	6,500
Clay.....	-----	-----	-----	-----	-----	-----
Cleveland.....	33,122	6,980	40,102	20,264	4,200	24,464
Columbus.....	-----	16,000	16,000	-----	2,175	2,175
Craven.....	-----	17,174	17,174	11,000	43,241	54,241
Cumberland.....	-----	24,365	24,365	-----	15,038	15,038
Currituck.....	-----	-----	-----	-----	-----	-----
Dare.....	-----	-----	-----	-----	-----	-----
Davidson.....	6,304	6,050	12,354	-----	2,785	2,785
Davie.....	-----	2,700	2,700	-----	-----	-----
Duplin.....	-----	2,364	2,364	-----	640	640
Durham.....	-----	44,957	44,957	-----	21,180	21,180
Edgecombe.....	-----	21,650	21,650	-----	24,781	24,781
Forsyth.....	-----	92,014	92,014	-----	48,815	48,815
Franklin.....	1,188	10,500	11,688	103	-----	103
Gaston.....	4,650	22,324	26,974	1,419	27,365	28,784
Gates.....	-----	100	100	-----	-----	-----
Graham.....	-----	-----	-----	-----	-----	-----
Granville.....	48,973	16,050	65,023	11,092	23,150	34,242
Greene.....	-----	4,000	4,000	-----	800	800
Guilford.....	7,441	183,545	190,986	144	51,792	51,936
Halifax.....	-----	44,800	44,800	-----	28,100	28,100
Harnett.....	-----	2,800	2,800	-----	3,000	3,000
Haywood.....	17,400	-----	17,400	15,075	-----	15,075
Henderson.....	11,463	44,300	55,763	4,500	32,425	36,925
Hertford.....	-----	-----	-----	-----	-----	-----
Hyde.....	-----	-----	-----	-----	-----	-----
Iredell.....	3,028	28,200	31,228	1,724	18,050	19,774
Jackson.....	90,940	-----	90,940	60,600	-----	60,600
Johnston.....	-----	19,550	19,550	-----	21,925	21,925
Jones.....	-----	-----	-----	-----	-----	-----
Lee.....	-----	-----	-----	-----	3,000	3,000
Lenoir.....	-----	55,875	55,875	-----	14,650	14,650
Lincoln.....	6,500	15,265	21,765	1,500	6,649	8,149
McDowell.....	12,480	1,100	13,580	849	3,300	4,149
Macon.....	36,625	1,000	37,625	27,200	6,650	33,850
Madison.....	30,855	-----	30,855	11,180	-----	11,180
Martin.....	-----	670	670	-----	8,670	8,670
Mecklenburg.....	13,872	45,200	59,072	13,071	20,500	33,571
Mitchell.....	190,569	-----	190,569	128,647	-----	128,647

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN  
1907 AND 1903.—CONTINUED.

County	1907			1903		
	Mineral Pro- duction Including Kaolin	Clay Products Except Kaolin	Totals	Mineral Pro- duction Including Kaolin	Clay Products Except Kaolin	Totals
Montgomery.....	\$ 52,848	\$ 5,000	\$ 57,848	\$ 60,028	\$ 7,925	\$ 67,953
Moore.....	11,519	8,150	19,669	18,250	4,710	22,960
Nash.....	5,600	28,000	33,600	20,100	—	20,100
New Hanover.....	35,973	18,750	54,723	12,480	22,500	34,980
Northampton.....	—	—	—	—	—	—
Onslow.....	—	—	—	—	—	—
Orange.....	10,098	3,913	14,011	295	7,000	7,295
Pamlico.....	—	—	—	—	—	—
Pasquotank.....	—	14,275	14,275	—	12,475	12,475
Pender.....	—	7,250	7,250	—	—	21,600
Perquimans.....	—	1,400	1,400	—	—	2,500
Person.....	30,973	2,400	33,373	5,835	—	5,835
Pitt.....	—	15,000	15,000	—	28,165	28,165
Polk.....	22,670	—	22,670	4,165	—	4,165
Randolph.....	300	20,704	21,004	87	10,242	10,329
Richmond.....	—	—	—	68,841	2,700	71,541
Robeson.....	—	8,350	8,350	—	14,540	14,540
Rockingham.....	58,950	5,075	64,025	27,300	2,850	30,150
Rowan.....	475,269	47,300	522,569	323,634	16,500	340,134
Rutherford.....	17,659	7,956	25,615	18,403	3,400	21,803
Sampson.....	—	—	—	—	2,350	2,350
Scotland.....	17,250	500	17,750	10,000	1,200	11,200
Stanly.....	50	1,400	1,450	1,058	2,100	3,158
Stokes.....	3,865	1,019	4,914	2,770	6,180	8,950
Surry.....	286,154	19,000	305,154	176,031	15,125	191,206
Swain.....	92,549	—	92,549	67,143	—	67,143
Transylvania.....	4,310	—	4,310	3,490	—	3,490
Tyrrell.....	—	—	—	—	—	—
Union.....	521	38,113	38,634	2,151	42,070	44,221
Vance.....	8,400	—	8,400	5,775	—	5,775
Wake.....	5,478	41,515	46,993	12,475	46,689	59,164
Warren.....	46,478	—	46,478	90,380	—	90,380
Washington.....	—	—	—	—	—	—
Watauga.....	30	—	30	—	—	—
Wayne.....	1,045	51,500	52,545	1,025	40,500	41,525
Wilkes.....	118	7,350	7,468	188	5,300	5,488
Wilson.....	—	44,850	44,850	19,892	34,032	53,954
Yadkin.....	—	560	560	—	1,100	1,100
Yancey.....	60,035	—	60,035	30,000	—	30,000
Unknown.....	2,014	—	2,014	35	750	785
Totals.....	\$ 1,857,414	\$ 1,316,308	\$ 3,173,732	\$ 1,326,799	\$ 944,317	\$ 2,307,116



VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA  
IN 1909 AND 1910.

County	1909	1910
	Total Value of Mineral Production	Total Value of Mineral Production
Alamance.....	\$ 33,900	\$ 35,520
Alexander.....	1,398	750
Alleghany.....	400	500
Anson.....	5,850	13,103
Ashe.....	155	500
Avery.....		
Beaufort.....	26,923	21,790
Bertie <i>a</i> .....		<i>a</i>
Bladen.....		<i>a</i>
Brunswick.....		
Buncombe.....	82,844	64,505
Burke.....	23,285	16,263
Cabarrus.....	21,796	21,229
Caldwell.....	17,800	6,865
Camden <i>b</i> .....		<i>b</i>
Carteret.....		
Caswell.....		
Catawba.....	35,695	25,146
Chatham.....	2,600	13,480
Cherokee.....	31,283	22,325
Chowan <i>b</i> .....		<i>b</i>
Clay.....		
Cleveland.....	39,273	18,059
Columbus.....	10,081	3,550
Craven.....	52,371	48,916
Cumberland.....	26,145	29,621
Currituck.....		
Dare.....		
Davidson.....	2,353	145
Davie.....	2,560	8,200
Duplin <i>c</i> .....		<i>c</i>
Durham.....	41,794	40,558
Edgecombe.....	25,362	17,073
Forsyth.....	54,648	45,659
Franklin.....	39	1,041
Gaston.....	14,583	16,034
Gates.....		
Graham.....		
Granville.....	48,342	19,170
Greene.....		1,500
Guilford.....	190,415	197,404
Halifax.....	47,054	35,550
Harnett.....	2,678	1,600
Haywood.....	1,550	7,075
Henderson.....	99,480	60,882
Hertford.....		3,000
Hoke.....		
Hyde.....		
Iredell.....	27,736	12,949
Jackson.....	51,599	53,804
Johnston.....	33,062	21,458
Jones.....	12	1,050
Lee.....	7,694	5,200
Lenoir.....	<i>d</i>	7,136
Lincoln.....	12,092	3,807
McDowell.....	2,850	14,594
Macon.....	45,732	50,300
Madison.....	21,785	20,824
Martin.....	5,436	5,347
Mecklenburg.....	63,701	80,678
Mitchell.....	191,777	259,127
Montgomery.....	8,692	62,305
Moore.....	16,200	27,470
Nash.....	18,081	13,500
New Hanover.....	59,138	48,250
Northampton.....		
Onslow.....		
Orange.....	27,972	

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA  
IN 1909 AND 1910.—CONTINUED.

County	1909	1910
	Total Value of Mineral Production	Total Value of Mineral Production
Pamlico.....	\$.....	\$.....
Pasquotank.....	<sup>e</sup>	25,900
Pender.....	18,200	<sup>i</sup>
Perquimans.....	<sup>e</sup>	
Person.....		17,450
Pitt.....	28,512	26,070
Polk.....	5,930	19,045
Randolph.....	16,403	21,703
Richmond.....		
Robeson.....	9,234	16,227
Rockingham.....	310,784	47,750
Rowan.....	178,984	397,930
Rutherford.....	20,857	3,125
Sampson.....	4,723	1,900
Scotland.....		8,100
Stanly.....	12,263	12,032
Stokes.....	49,552	53,504
Surry.....	166,394	278,728
Swain.....	99,564	80,983
Transylvania.....	7,337	6,770
Tyrrell.....		
Union.....	52,003	45,300
Vance.....	75,396	17,220
Wake.....	63,308	69,155
Warren.....	<sup>f</sup>	54,344
Washington.....		
Watauga.....	<sup>g</sup>	<sup>j</sup>
Wayne.....	46,338	59,810
Wilkes.....	6,685	6,536
Wilson.....	40,716	34,350
Yadkin.....	812	420
Yancey.....	32,660	59,284
Unknown.....	945	
Totals.....	\$2,783,826	\$ 2,848,446

<sup>a</sup> Included with Beaufort County; <sup>b</sup> Included with Caldwell County; <sup>c</sup> Included with Durham County; <sup>d</sup> Included with Lee County; <sup>e</sup> Included with Orange County; <sup>f</sup> Included with Vance County; <sup>g</sup> Included with Wayne County; <sup>h</sup> Included with Cherokee County; <sup>i</sup> Included with Pasquotank County; <sup>j</sup> Included with Warren County.



PUBLICATIONS  
OF THE  
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

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BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp. 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglas B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Water-powers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*
23. Forest Conditions in Western North Carolina, by J. S. Holmes, 1911. 8°, 115 pp., 8 pl. *Postage 15 cents.*

## ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

↳ Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines, in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.



15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Postage 3 cents.*

23. Mining Industry in North Carolina During 1908, '09, and '10, by Joseph Hyde Pratt and Miss H. M. Berry, 1911. 8°, 134 pp., 1 pl., 27 figs. *Postage 10 cents.*

Gives report on Virginiana Copper District of North Carolina and Virginia, by F. B. Laney; Detailed report on Mica Deposits of North Carolina, by Douglas B. Sterrett; Detailed report on Monazite, by Douglas B. Sterrett; Reports on various Gem Minerals, by Douglas B. Sterrett; Information and Analyses concerning certain Mineral Springs; Extract from Chance Report of the Dan River and Deep River Coal Fields; Some notes on the Peat Industry, by Professor Charles A. Davis; Extract from report of Arthur Keith on the Nantahala Marble; Description of the manufacture of Sand-line Brick.

24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

#### VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Coastal Plain Deposits of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson and Horatio N. Parker.

Pt. I.—The Physiography and Geology of the Coastal Plain of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller and L. W. Stephenson.

Pt. II.—The Water Resources of the Coastal Plain of North Carolina, by L. W. Stephenson and B. L. Johnson. *In Press.*

#### BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp.  
*Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp.  
*Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp.  
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Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp.  
*Postage 2 cents.*

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Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp.  
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Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp.  
*Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report. Contains Agreements for Coöperation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract, Buncombe County; Transylvania County State Farm; certain Watersheds; Reforestation of Cut-over and Abandoned Farm Lands; on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

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Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

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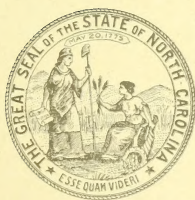
ECONOMIC PAPER No. 24

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# FISHING INDUSTRY OF NORTH CAROLINA

BY

JOSEPH HYDE PRATT, Ph.D.



RALEIGH

E. M. UZZELL & CO., STATE PRINTERS AND BINDERS

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Figure 1



## LETTER OF TRANSMITTAL.

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CHAPEL HILL, N. C., December 1, 1911.

*To His Excellency, HONORABLE W. W. KITCHIN,*

*Governor of North Carolina.*

SIR:—A Fish Convention has been called by the North Carolina Geological and Economic Survey, the North Carolina Fish Commission, and the North Carolina Oyster Commission, in order to discuss the report made by the special committee appointed by the Legislature of 1909, with a view to checking the great decrease in the fishing industry of eastern North Carolina. I submit herewith for publication Economic Paper No. 24, which gives the report of this committee, together with certain information with regard to the fishing industries and the work of the committee; and it is believed that this report will further the work of this convention.

Yours respectfully,

JOSEPH HYDE PRATT,  
*State Geologist.*





# FISHING INDUSTRY OF NORTH CAROLINA.

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By JOSEPH HYDE PRATT, PH.D.

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The three natural industries from which a State derives its wealth are: (1) Agriculture and Forestry; (2) Mining; and (3) Fishing. Upon these three industries all the others are dependent for their raw material. Splendid progress and advancement have been made in agriculture and forestry, and in mining, and measures have been advanced and legislation passed to protect and conserve the natural resources connected with these two industries. In some States this is also true of the fishing industry. In North Carolina, however, our General Assemblies have not looked upon this industry as of any particular value to the State, but have considered it as simply a local or county question. Instead of its being a local question, the fishing problem is a State-wide matter; because, in the first place, the navigable waters in the State are absolutely under the control of the Federal and State governments and the fish that live in these waters belong to the State as a whole, and not to the county or community in which the waters happen to be located; in the second place, every person in North Carolina has a perfect and constitutional right to fish in any of the navigable waters belonging to the State, and because of such right is interested from a personal standpoint in the protection and conservation of the fishes inhabiting these waters; and, in the third place, the protection of the fish and the fostering of the fishing interests cannot be carried on by the county, but must be undertaken by the State, if the measures advocated are to be successfully carried out. Thus in passing laws to protect and foster our fishing industries, we must consider the State before the county, and the whole people before the individual.

This lack of consideration of this important problem as a State measure was never more strikingly illustrated than during the past session (1911) of the General Assembly of North Carolina. At this session a State-wide fish bill, which had been prepared as a result of a very thorough and systematic investigation by a special committee appointed by the General Assembly of 1909 and which had been considered and thoroughly discussed in joint meetings of the fish committees of the House and Senate, and was the bill finally agreed upon, was passed by the House, but defeated in the Senate on account of *senatorial courtesy*. Because certain Senators did not want the act to apply to their counties,

these counties were excepted, thus destroying the value and purport of the bill, the Senate not realizing that this was a State-wide measure, and must be considered as such to be effective.

#### PRODUCTION OF FISH.

If one will take the time to investigate the fishing conditions in North Carolina and the value of the output of this industry, he will be surprised at its constant decrease in value from year to year. Instead of the fishing industry being worth from *seven* to *eight* million dollars to eastern North Carolina, it is now worth less than *two* million. The latest available statistics on the catch of fish in North Carolina is a report of the United States Bureau of the Census for the year 1908, and it also gives some very interesting figures regarding this industry in North Carolina. This report shows that in 1908 there were in North Carolina 9,681 persons employed in the fishing industry; that the capital invested in vessels and boats, including outfit, was \$533,000; in apparatus of capture \$367,000; in shore and accessory property and cost \$370,000. These figures give a little idea of the importance of the industry at the present time.

Since 1902 there has been a decline in the number of persons employed and a corresponding decrease in the value of the vessels, apparatus of capture and other equipment. The vessel fisheries gave employment in 1908 to only a small percentage of the total number of persons reported. The shore and boat fisheries are credited with 8,571 persons, or 89 per cent of the total number, while 1,066, or 11 per cent, were engaged in the vessel fisheries and on the transporting vessels. Only 44 shoresmen were reported. By far the larger number of persons reported for vessel fisheries and transporting vessels were wage-earners. For the shore and boat fisheries of North Carolina a larger proportion of wage-earners and a smaller proportion of independent fishermen were reported than for the same class of fisheries in other States. Many of the persons employed in the industry fished only a part of the year, and during the remainder of the time engaged in farming and other occupations.

The statistics relating to the catch of fish include more than forty species of fish, including oyster, clams, and other mollusca; but do not include frogs, crab, shrimp, otter, whalebone, and whale oil, or the hides and oil of porpoise. All of these latter have been produced in small amount in this State at different times. The United States Bureau of Fisheries, in reply to a letter from the State Geologist, has made a very careful comparative analysis of the statistics of 1902 and 1908, and this letter is here given:



## DEPARTMENT OF COMMERCE AND LABOR

## BUREAU OF FISHERIES

WASHINGTON

February 18, 1910.

DR. JOSEPH HYDE PRATT, *State Geologist*,  
*Chapel Hill, N. C.*

SIR:—In reply to your inquiry, you are informed that this Bureau cannot furnish you, in the form or detail which you desire, a comparison between the fisheries of North Carolina five years ago and at the present time. The Bureau has made no statistical canvass of the State since 1902, and the recent inquiry conducted by the Bureau of the Census was on a different basis, and such information as it furnishes applies to the State as a whole and is incapable of analysis in respect to the several counties.

The Bureau has prepared from the data available the appended Table I, making a comparison of the catch of the important species of fishes in the years 1902 and 1908, respectively. As the condition of the fisheries in respect to the necessity of regulation is indicated by the quantity caught rather than by the value of the catch, the comparison is based on the former factor, though the value of the product of each species in the year 1908 is shown to exhibit their comparative commercial importance.

TABLE I.—CATCH OF FISH IN NORTH CAROLINA DURING 1908.

SPECIES.	1902.	1908.		Quantity, Decrease Per Cent.
	Quantity, Pounds.	Quantity, Pounds.	Value.	
Alewives (Herring).....	11,172,975	10,927,000	\$ 140,380	2.2
Black bass.....	632,675	511,300	39,610	17.3
Bluefish.....	977,142	1,256,500	45,170	*22.2
Butterfish.....	83,218	1,302,000	28,990	*1,469.0
Croakers.....	2,928,635	1,177,100	31,190	39.0
Flounders.....	261,762	402,900	16,390	*54.0
Hickory shad.....	684,896	377,000	20,230	45.0
Kingfish or whiting.....	120,480	816,600	27,710	*580.0
Menhaden.....	18,862,000	57,412,300	70,330	*204.0
Mullet.....	6,705,492	5,070,500	174,760	21.0
Perch (white and yellow).....	1,047,042	1,353,300	58,270	*29.0
Shad.....	6,566,724	3,942,300	372,920	40.0
Spanish mackerel.....	354,084	457,300	34,210	*29.0
Spot.....	872,695	852,300	15,720	2.0
Squeteague or trout.....	3,781,456	4,634,600	206,240	*23.0
Striped bass.....	1,175,400	509,700	36,250	111.0
Total.....	63,764,984	97,772,300	\$ 1,776,020	-----

\*Increase.

It will be observed that the total catch of fish in 1908 exceeded that of 1902 by over 35,000,000 pounds, or about 65 per. cent, though, it may be remarked, the value of the catch was less than 4 per cent greater. The increase in the catch was almost wholly due to the fishery for menhaden, which has annually grown more intense and important for the past ten years, and more than trebled in its product between 1902 and 1908. Considering the food fishes alone, the total catch of the fifteen species enumerated has decreased about 5 per cent in quantity and the value has increased about the same percentage. For practical purposes the two may be regarded as on an equality in the two years cited. An analysis of the details of the table shows wide variation in the catch of the individual species, eight exhibiting a decrease and seven an increase in the year 1908.

The species which show an apparent decrease in abundance are mainly those which were most valuable in 1902. Of those whose value exceeded \$50,000 in that year the catch of five decreased and two increased. Of the less valuable fishes six exhibit an increase and three a decrease in the quantity caught.

It would appear, therefore, that as the more valuable species, such as the shad, became scarcer, the fishermen put forth greater exertion to take the less valuable fishes, and that many which before were more or less discarded were placed on the market. This is a common phenomenon of a fishery becoming depleted.

A further analysis shows that of the fishes exhibiting a decrease in 1908, the majority were either anadromous or resident species, that is, fishes which are more certainly affected by the local fisheries of North Carolina, while those species which were caught in increased abundance were mainly those ranging widely or which do not habitually return to their native waters. Of the anadromous class we have the alewives, hickory shad, shad, and striped bass, which have decreased, while the white perch has increased. The mullet, which may be called semi-anadromous, has decreased.

Of the resident species we have two, one of which, the black bass, has decreased, while the flounder has increased very materially in the catch. The latter is one of the fishes more highly regarded than formerly, its price rising from 2 cents per pound in 1902 to over 4 cents in 1908; and it is probably true in North Carolina, as in other places, that many are now saved by the fishermen and shipped, when formerly they were thrown away as trash fish.

Of the strictly pelagic, or widely wandering, fish, three species are listed. These are the bluefish, the Spanish mackerel, and the squeteague, the catch of all of which was greater in 1908 than in 1902. Of what may be called semi-wandering species there are four, of which the butterfish and the kingfish or whiting have increased, the croakers have decreased, while the quantity of spots taken has remained nearly stationary. These four species move back and forth between the sea and the sounds without much system.

From the foregoing it appears reasonable to deduct the conclusion that those fishes have decreased for which there has been a good demand, and which were therefore the objects of an intense fishery, and which at the same time had habits making them especially susceptible to the influence of the local fishery. The fishes of which a greater quantity are now caught are those for which there was formerly an inferior demand and which have more or less wandering habits, not leading them to return to State waters.



Of the shad which for years has constituted between 30 and 40 per cent of value of the catch of fishes, excluding the oyster and other shellfishes, the Bureau can speak with confidence. In 1897 there were caught 8,963,488 pounds, valued at \$362,811; in 1902, 6,566,724 pounds worth \$384,808, and in 1908, 3,942,300 pounds, yielding the fishermen \$372,920. While the value of the catch has remained practically stationary, the quantity has decreased 40 per cent since 1902 and 127 per cent since 1897. Between 1897 and 1902 there was an increase of 115 per cent in pound nets, 50 per cent in seines, and a decrease of about 50 per cent in the gill nets in use in the State.

Between 1901 and 1905 the supply of ripe eggs which the Bureau was able to obtain for its hatchery at Edenton fell from 75,000,000 to 6,748,000. Since 1905 the yield has gradually risen from the low level stated to 59,685,000 in 1909. The average annual yields for three-year periods since 1901 have been as follows:

1901-1903.....	49,900,000 eggs.
1904-1906.....	10,889,000 eggs.
1907-1909.....	46,398,000 eggs.
1909-.....	59,685,000 eggs.
1910-.....	69,000,000 eggs.

The yield for 1909 was higher than for any year since 1901.

The reason for the decrease in the first two periods and for the increase in the third appears not difficult of determination. The eggs are all obtained at the upper end of Albemarle Sound, and the ripe fish taken there, in their course from the sea to the spawning grounds, must first pass through the narrow confines of the inlets and sounds, where they are especially open to capture. Prior to 1906 there was a great increase in the number of nets of all kinds, and they were fished in such manner that they served as almost complete barriers to the passage of the fish.

In 1905 a law was passed maintaining an open channel, free from nets of all kinds from the inlets to the spawning grounds, and in 1906 its effect became apparent by an increase in the number of eggs taken to 25,643,000 from the insignificant take of 6,748,000 in the previous year, and by 1909 the take had again more than doubled.

The Bureau has no data from which to determine whether the catch of shad in the upper sounds has increased since 1906, but there is little doubt that it has, as stated by the fishermen, and there can be no doubt that a much larger proportion of the fish are propagating both through natural means and the agency of the hatchery.

These facts furnish the clue to the means by which the fisheries of North Carolina may be fostered and perpetuated. The fish must be given access to their spawning grounds, and the hatchery must be granted every facility for obtaining its supply of eggs. The nets must be restricted as to location and if necessary as to number and size so as to furnish an avenue of passage for the fish. Furthermore, the laws must be so drawn that, while restricting reckless fishing, they must not interfere with the capture of fish for the specific purposes of artificial propagation, nor make the cost of obtaining ripe eggs so high as to be prohibitive.

That these ends may be effectively attained it is obligatory that the administration of the laws be vested in State officers and not committed to county

authority with local prejudices and a limited purview. Local regulation of the fisheries has everywhere proved a complete failure, and to experiment with it is to invite disaster to the fisheries committed to its care.

[Signed]

GEO. M. BOWERS,  
*Commissioner.*

One noticeable fact that is brought out in this discussion is, that the fish that were the most valuable and important in 1902, such as the shad, black bass, mullet, and striped bass, all showed a very decided decrease in quantity and value in 1908, and those that increased were principally fish which were considered as having no particular value for market in 1902, such as the butterfish. The great increase in the total quantity of fish caught in 1908 as compared with 1902 is due to the catch of menhaden, which are used for the extraction of oil and fertilizer purposes. The increase in value between the 18,862,000 pounds caught in 1902 and the 57,412,000 pounds caught in 1908 was only \$39,000. This particular side (fishing for menhaden) of the fishing industry has constantly increased since 1902.

Special attention should be called to the catch of mullet. While the total weight of the mullet catch of 1908 was over one and one-half million pounds less than 1902, yet the total number of fish of the 1908 catch was very much in excess of that of 1902, and was due to the fact that young mullet are now caught and put on the market which sometimes do not bring a sufficient price to pay the transportation charges on them. If these mullets had been allowed to remain in the water for another year, they would, on account of their rapid growth, have increased to a very marketable fish and would be worth several times per pound more than when marketed as small fish.

North Carolina has for years produced the greatest number of shad of any of the Southern States; but, in 1908, the Virginia catch was considerably in excess of that of North Carolina.

One other point that is emphasized by this statistical report is the absence of any statistics regarding sturgeon, a fish which at one time was caught in considerable numbers in the North Carolina waters, but which now is slowly becoming exterminated. Laws should be passed and enforced for the protection of this fish, as it would be possible in a few years with sufficient protection to bring the sturgeon industry back to a paying basis in this State.

As is seen from the above table, the total value of the fish, exclusive of oysters, clams, and other mollusca, caught in North Carolina during 1908 was \$1,776,000. The value, however, of the oyster and other shellfish did not bring the total value of the fishing industry in North Carolina up to the two-million-dollar mark.



## PRODUCTION OF OYSTERS.

The oysters produced in the fishing season of 1907-08, as reported by the Oyster Commissioner, amounted to 210,832 bushels, which, valued at 30 cents per bushel, gives a total value of \$63,249. During the fishing season of 1901-02 the catch reported was 693,516 bushels, which at that time was valued at an average of 25 cents per bushel.

In the following table is given the catch of oysters from the year 1902 to 1908, inclusive:

OYSTERS PRODUCED IN NORTH CAROLINA, 1902-'08.

Season.	Number of Bushels.
1901-02.....	693,516
1902-03.....	658,769
1903-04.....	505,131
1904-05.....	531,854
1905-06.....	351,429
1906-07.....	349,979
1907-08.....	210,832

There are several reasons for this decrease other than the depletion of the natural beds, although the latter is the chief cause. We can sum up the cause of the depletion of the beds, however, to the fact that the laws passed for protecting these oyster beds have not been enforced. The State of Virginia holds first place in the country in the oyster industry; and, when considered amongst the southern States, Virginia is first and Maryland second. As was stated in a recent article by the Oyster Commissioner of Virginia:\* "Maryland is far behind Virginia in the laws, methods, and administration of its oyster industry, while North Carolina and other South Atlantic States are hardly in the running." The article also makes the statement that: "In four days time during the present season there were taken from the beds of either the James or Potomac rivers more and better oysters than were cropped in the whole State of North Carolina during the past season." And the 40,000 bushels a day was not an uncommon catch from either rivers at the beginning of the season of 1910. It is estimated that the Virginia catch of oysters for 1910-11 was approximately three and one-half million dollars, while the catch of North Carolina oysters was not over \$50,000. Practically, the Virginia industry is seventy times that of the North Carolina, and yet we have a tremendous area in which the oyster will grow naturally and can be profitably cultivated. Un-

\*"Virginia Fishing Industry," Oysterman and Fisherman, April, 1911, p. 9.

doubtedly, the one thing that is reacting against North Carolina is the fact that we are not doing anything to protect and conserve our natural rocks or encourage the cultivation of the oyster.

The following table will give a comprehensive idea of the value of the fish and oyster industries of the South Atlantic States, as far as they could be obtained, and, for comparison, the value of these fishes in New Jersey and Connecticut are given:

STATISTICS OF FISH AND OYSTER INDUSTRIES FOR THE YEAR 1908.

State.	Fish.	Oysters.	
	Value.	Bushels.	Value.
Maryland .....	\$ 1,078,000	6,230,000	\$ 2,228,000
Virginia .....	2,368,000	4,075,000	2,348,000
North Carolina .....	1,776,000	210,832	63,249
Georgia .....	362,000	1,459,000	339,000
Florida .....	*3,093,000	-----	296,000
Connecticut .....	499,000	-----	2,583,000
New Jersey .....	2,700,000	2,586,000	1,369,000

\*This includes the value of the sponges and of the alligators.

Another interesting fact to be drawn from the statistics regarding the oyster is given in the following table, which shows what proportion of the catch of oysters were taken from cultivated grounds and what proportion from the natural rocks in the different States:

CATCH OF OYSTERS FROM PUBLIC AND PRIVATE BEDS IN 1908.

State.	From Public (Natural Rock).		From Private or Cultivated Beds.		Total.	
	Bushels.	Value.	Bushels.	Value.	Bushels.	Value.
Maryland .....	6,076,000	\$ 2,142,000	154,000	\$ 86,000	623,000	\$ 2,228,000
Virginia .....	-----	-----	-----	-----	4,075,000	2,348,000
North Carolina .....	199,832	54,644	11,000	8,605	210,832	63,249
Georgia .....	507,000	*101,000	952,000	*238,000	1,459,000	339,000
Florida .....	-----	296,000	-----	-----	-----	296,000
Connecticut† .....	-----	-----	-----	-----	-----	2,583,000
New Jersey .....	-----	249,000	-----	1,120,000	-----	1,369,000

\*Estimated.

†Principally from private beds.

It will be noticed from the above table that the oyster catch in most of the States was largely from cultivated beds, in some States the production from the cultivated beds being much greater than from the



natural rocks. In North Carolina the production from cultivated beds is extremely small, although the State is abundantly supplied with bottoms well suited to the cultivation of the oyster.\*

#### LEGISLATIVE FISH COMMITTEE OF 1909.

The General Assembly of 1909, after the introduction of numerous fish and oyster bills, finally settled the whole question *for that year* by passing the following resolution:

#### A JOINT RESOLUTION RELATING TO THE PROMOTION OF THE FISHERY INDUSTRY OF NORTH CAROLINA.

Realizing the great value of the fisheries to the State of North Carolina, that these fisheries are being rapidly depleted, and that some measures are necessary to prevent this depletion, and that steps should be taken to foster and perpetuate these industries: therefore, be it

*Resolved by the House of Representatives, the Senate concurring:*

SECTION 1. That there shall be created a committee of seven, three to be appointed by the Speaker of the House from the members of the House of Representatives and two by the President of the Senate from the members of the Senate. Of the three members of the House one shall be from the western part of the State, one from the central part of the State, and the third from the eastern part. The President of the Senate shall appoint one member from eastern North Carolina and one from the central part of the State. None of the seven members of the committee shall be financially interested in any of the fisheries. The President of the Senate and Speaker of the House of Representatives shall be members of said committee.

SEC. 2. This committee shall thoroughly investigate the fisheries of North Carolina, including finfish, oyster, clam, and other mollusca, crab, lobster, terrapin, etc., and make a report in the form of a bill, to be presented to the Legislature of 1911, which will embody such legislation as in their judgment they deem best for the building-up of the fisheries of North Carolina.

SEC. 3. In order to facilitate the work of this committee, they are hereby authorized to request the Commissioner of the United States Bureau of Fisheries to detail one of their experts to sit with the committee during its deliberations. The committee is further authorized to visit and examine any portion of the waters of North Carolina which they deem necessary in order to fully inform themselves upon the existing conditions relating to the fishery industries. This committee is also further authorized to use the State boat under the control of the Oyster Commissioner in going from one part of the rivers and sounds of eastern North Carolina to another. The committee is also further authorized to call in for consultation the Fish Commissioner, the Oyster Commissioner, the State Geologist, and other public servants that they believe can give them any information of value regarding the fishery industries. They are further authorized to sit at some central point in eastern North Carolina, after they have visited what places they deem necessary for the collection of information, where delegations of fishermen or representatives

\*See Bulletin 15, on the Cultivation of the Oyster in North Carolina.

of fishermen from various portions of eastern North Carolina can appear before the committee to give information regarding the fisheries of the State.

SEC. 4. The committee shall be allowed all their actual expenses attending to this work and four dollars per diem while in the actual performance of their duties, but the per diem shall not be for more than thirty days.

SEC. 5. This act shall be in force from and after its ratification.

Ratified this the 4th day of March, A. D. 1909.

The committee appointed under this act consisted of the following: Lieutenant Governor W. C. Newland, President of the Senate; Judge A. W. Graham, Speaker of the House; Senators E. L. Travis of the Fourth District and John A. Barringer of the Twenty-first District; Representatives R. A. Doughton of Alleghany, Harry Stubbs of Martin, and J. H. Currie of Cumberland. The U. S. Bureau of Fisheries was asked to send an expert to serve on this committee, and Dr. H. F. Moore of that Bureau rendered very able assistance in connection with this investigation. The committee was also assisted by the State Geologist.

#### OUTLINE OF WORK OF COMMITTEE.

The committee planned out its work as follows:

First, to make a trip into eastern North Carolina at a time when meetings could be held at various points to which the fishermen could come and give information regarding the industry in their section, and also discuss with this committee various fishing problems.

Second, to make another visit in the spring during the height of the fishing season when the fishermen could be visited while at their work.

Third, to hold sufficient committee meetings to enable its members to thoroughly comprehend the information collected, and to draft from this information a bill which the committee would believe would be satisfactory to the fishing public of North Carolina.

This program was very exactly carried out. The first trip was made in July, 1909, the following itinerary being carried out without a single change:

#### *1909 Itinerary of Fish Committee.*

- |            |          |  |
|------------|----------|--|
| Tuesday,   | July 6.  | Assemble at Edenton. Spend the day going up Chowan River, across the sound to mouth of Roanoke River.  |
| Wednesday, | July 7.  | Public meeting at Edenton. Fishermen from Pasquotank, Perquimans, Chowan, Gates, Hertford, Bertie, Washington, and Tyrrell counties attended this meeting. |
| Friday,    | July 9.  | Public meeting at Manteo, Dare County. Trip to Nags Head.  |
| Saturday,  | July 10. | Sail around Roanoke Island, noting conditions at Oregon Inlet, New Inlet, Marshes, etc.  |
| Sunday,    | July 11. | Nags Head.   |



Monday,	July 12.	Meeting at Point Harbor, Currituck County. Fishermen in Camden and Currituck counties attended.
Tuesday,	July 13.	Manteo to Stumpy Point, to Long Point and to Hatteras. Meeting at Hatteras at night.
Wednesday,	July 14.	Informal meeting at Hatteras in a. m. These meetings accommodated the fishermen all along the Banks from Ocracoke Inlet to Cape Hatteras.
Thursday,	July 15.	Meeting at Swan Quarter in a. m. for fishermen and oystermen from Hyde and parts of Beaufort and Pamlico counties.
Friday,	July 16.	Meeting at Washington, Beaufort County.
Saturday,	July 17.	Sail from Morehead City to Atlantic, examining Core Sound and Beaufort Harbor.
Monday,	July 19.	Meeting at Beaufort. For the fishermen and oystermen from Carteret and part of Craven counties.
Tuesday,	July 20.	Examination of conditions in Carteret County and Government Laboratory.
Wednesday,	July 21.	Meeting at New Bern, Craven County.
Thursday,	July 22.	Meeting at Jacksonville, Onslow County.
Friday,	July 23.	Meeting at Wilmington, New Hanover County.
Saturday,	July 24.	Meeting at Southport, Brunswick County.

The committee were accompanied on this trip by Dr. H. F. Moore, expert of the United States Bureau of Fisheries, and Dr. Joseph Hyde Pratt, State Geologist; and part of the time by T. H. Meekins, Fish Commissioner, and W. M. Webb, Oyster Commissioner. The Oyster Commission furnished the *Atlantic*, the boat belonging to that commission. Two stenographers, Miss H. M. Berry of Chapel Hill and Miss Sophia Busbee of Raleigh, were in attendance at all these meetings, and all the testimony and information was accurately recorded. These meetings were conducted similarly as if they had been held at Raleigh during the session of the General Assembly.

The first meeting was held at Edenton, July 7, 1909, Lieutenant Governor Newland presiding. In opening the meeting he said:

*Gentlemen:* We are here in obedience to a resolution passed by the State Legislature, hoping that we might, after visiting the waters in eastern North Carolina, make some recommendations to the next Legislature that would be beneficial to the fishing interests of the State. And I would say that in obedience to that resolution we are here to-day. The proceedings of this committee will be in the nature of a legislative report, and it is earnestly requested that every citizen here will give the committee all the information he has, in order that we may be informed. This is your meeting and you are wanted to talk. We are here to hear you, not for you to hear us, for, speaking for myself, I know nothing about the fishing interests. I came here absolutely ignorant and unbiased, and we are here to hear you and to hear recommendations, and I will now ask Judge Graham to give in detail the object of this meeting.

Judge A. W. Graham, Speaker of the House of Representatives, spoke as follows:

*Mr. Chairman and Fellow-Citizens of Northeastern North Carolina:*

There are some people in North Carolina who think the fish and oyster interests are mere local matters and that the great body of the State has nothing to do with it, and that only such laws should be passed as are recommended and endorsed by the people of that locality. I am one among those who believe that we all compose one grand old State; that what is to the interest of the people of Chowan is likewise to the interest of Granville. We are a great State. There are many industries in North Carolina that redound to the credit of the State, and would reflect much more credit to the State if they were thoroughly prosecuted. The manufacturing interests are more in the central part of the State, in which I live; also the mining regions are in the part where I live and where the Lieutenant Governor lives. The agricultural interests predominate in our State and are of joint interest to us all. The fishing interest, which I class second to none of them, is peculiarly the interest of this section of North Carolina, and it is one in which every true North Carolinian ought to take a deep interest, because we cannot benefit one portion of our State without all of us receiving some influences that tend to the upbuilding of our own State.

It has been my fortune, some say misfortune, like every other gentleman of the committee, to have been a member of the Legislature for many years. I have listened, with great interest, to the discussions of these oyster and fish problems by the members of the Legislature from this section, and from my observation and from the information that I have obtained from the gentlemen from this section of North Carolina, I believe that you have within your grasp one of the greatest interests of this State. There is another thing that I have observed, though, and that is that the fishermen are never agreed among themselves. It is a peculiar fact, and some of you would be struck with the force of the remark if you could go up to the Legislature and listen to the discussions of the various matters by the gentlemen composing these committees. But for the fact that they are all so in earnest, you would think there was a regular circus going on at these committee meetings. If you attempt to carry out the views of one person about this matter, in the eyes of another you ruin the fishing interest of North Carolina. That does not take place at one session of the Legislature, but at absolutely every session. It is very difficult to understand why such a state of affairs should exist. To the men of the mountains and of the piedmont it seems almost inexplicable until you study the question and see that the same law that would be applicable to one portion of North Carolina would not work and prove beneficial to the others, and also to realize the fact that some men in certain portions of a district want very stringent laws passed in regard to the fishing in North Carolina, and they will advocate the most stringent law possible, and then at the end of the bill they will have another clause inserted: "*Provided, this does not apply to ..... County.*" Every fisherman wants the fishing law to apply to the county in which he does not live. But, I am glad to say, there seems to be more uniformity of sentiment; there seems to have been a broad-minded conception of the whole question aroused in this part of North



Carolina. After these matters were thoroughly discussed up there and the committees disagreed among themselves—and, mark you, that nearly every man on the committee was from this section of the State—it was thought best by those gentlemen that a commission be appointed in order to investigate these matters and recommend to the ensuing Legislature such laws as would be adapted to each section of the State and would not work an injustice to any.

So, upon a motion of a gentleman from this section, a resolution was presented authorizing the appointment of this committee, consisting of three members from the House of Representatives, one from the East, one from the Center, and one from the West, and the Speaker, and two members from the Senate, together with the President of the Senate. That is the reason the Lieutenant Governor and myself are here to-day. I will read this resolution. [Reads resolution.]

Now, gentlemen, we are here by virtue of that resolution. We are unfortunate in not having the services of Governor Doughton of Alleghany. He is a man of long experience in the Legislature and, you know, was for a while Lieutenant Governor. He is detained at home, and we will not have the benefit of his services. Mr. Currie of Cumberland is here; Senator Travis of Halifax is here; and Senator Barringer of Guilford will be here to-day. We come now with no preconceived ideas in regard to it. We are come with our minds open and unprejudiced, to talk with you, as brother to brother, because we are all interested in this matter. We are all now, as it were, in one great partnership. We want every man in this house, whether he is a professional man, whether he is a farmer, whether he is a fisherman or whether he is an everyday laborer, we want you all to feel that you have an interest in this matter, and to express your views freely to us to-day. Whatever tends to build up this grand section of northeastern North Carolina will certainly redound to the good of our State. We bespeak your hearty coöperation by giving advice and assistance, and if any man presents views that don't agree with the views of other gentlemen here, let us have a full and free discussion, because it is by rubbing together our minds that we will be able to reach some kind of a conclusion.

If you will take the map of North Carolina, examine and compare these waters of yours with the waters of Virginia, Maryland, and Connecticut, you will see that we have, perhaps, a greater area that could be rendered profitable, if proper laws were enacted, than any one of these States; but, unfortunately, I do not know what the reason is, last year Virginia made \$68,000 clear out of her fish and oysters; with not one-fourth the territory that you have here, Louisiana cleared \$18,000; and Connecticut, with not one-fourth the territory that you have, made \$38,000, while North Carolina went \$8,000 in debt. Is it in the administration of the law? Is it for the want of proper laws? What is the cause of these things?

I will say, though, that that loss was not in the conduct of the fish part, because we made a slight profit in the administration of the fish laws in North Carolina, but in the administration of the oyster laws in North Carolina we are now between \$8,000 and \$10,000 in debt, while other States have reaped a harvest.

At the conclusion of Judge Graham's remarks, Mr. Frank Wood of Edenton was called upon to read a paper which embodied the views of the fishermen of that section:

A thorough understanding by your committee of conditions in the fishing industry is greatly desired by us and we gladly offer any information we have to aid you to that end. The frequent appeals to the State for legislation for the protection of the industry is as distasteful and burdensome to us as it can be to the Legislature, and, with a view to avoiding that hereafter, two committees of practical fishermen met at Morehead in 1906 and 1908 and labored earnestly to agree upon a measure that would be acceptable to all; each side made concessions and the recommendations presented are the best obtainable. The fishing industry is of great value to our country and its maintenance of vital importance, not only because it is one of our chief sources of income, but because the shad and rock furnish a rare and valuable food supply to those who are able to pay high prices for delicacies at a season when they are rare and in best demand, and the herring supplies a good and wholesome food to our own people and our neighbors at lower prices than any other food of equal value can be bought for. These fish are all migratory and come into our waters to spawn, and here they find at the head of our sounds and rivers ideal conditions; they cannot spawn in cold, salt water, and must reach the warm, fresh water they find here. The legislation we sought for has been to open the inlets and middle of the sounds and rivers that these migratory fish may reach these waters, where our National Government has liberally aided nature in maintaining the supply of shad. The recommendations of the fishermen provide that in all sections the fishing shall be confined to certain distances from the shore, and the inlets and middle water be left open and free from obstruction. There was no difficulty in agreeing upon these recommendations, except at a few points in front of the inlets and the narrow parts of Croatan Sound. As can be seen on the charts, old and new, these points are directly in the line of passage of the fish to the spawning grounds, and are the most important points to be kept open. A very few nets can close them, and to permit fishing there will be to grant special privileges to a few and practically destroy the industry for the many. To these points we ask your special attention.

When the Legislature decided to postpone fish legislation until your investigation could be made, we did not expect any further consideration would be given to the matter; but a bill was passed just before the close of the session, without our knowledge or approval, which repealed the enforcing clause of the law and practically nullified all the legislation we have affecting the industry. The forbidden territory is definitely marked by the Vann law, and that law provided that nets set beyond the limits could be removed by the Fish Commissioner. But now it must be proven in a court of justice that the net is beyond the limit (a self-evident fact), and then the offender can be fined only \$50, while the privilege in many cases would be worth thousands of dollars to him.

If this committee can aid in the enforcement of the law until the enforcing clause of the Vann bill can be reinstated, it will be of great service to us.

To further show that our efforts have been for the advancement of the general fishing industry, I will ask you to note that one section of the recom-



mendations curtails our time for fishing, limits our territory, forbids the taking of certain small fish and forbids taking sturgeon at all for several years. All these recommendations were made by the fishermen, to maintain and replenish the supplies of fish, as it has become evident to us that the business is overdone and we will lose all unless changes are made.

At every meeting the question was asked, Do you think the best way to foster and develop the fishing industry of the State is to have all the counties interested in commercial fisheries under the jurisdiction of a Fish Commission? There was not a single meeting but that the sentiment expressed was to answer this question in the affirmative. The meetings also brought out the fact that practically no county was a unit as to what regulations would be best for the county, one fisherman wanting one thing and another something different, and in nearly every case the suggestions were for the benefit of a small community regardless of the effect on county or State.

At Manteo there were on exhibition the various kinds of nets and other apparatus that are used in fishing and oystering in North Carolina, thus enabling the members of the committee to become thoroughly familiar with fishing appliances.

These meetings were well attended and the fishermen entered heartily into the discussions and were very free in answering questions asked by members of the committee. The attendance at the meetings varied from forty to about three hundred. The information collected at these meetings was typewritten, and thus was readily accessible to each member of the committee.

#### *1910 Itinerary of Fish Committee.*

The second trip was made in March, 1910, and the fishermen were visited while actually engaged at their work. The following members of the committee met at Wilmington, March 14, 1910: A. W. Graham, R. A. Doughton, J. H. Currie, Dr. H. F. Moore, and Joseph Hyde Pratt. The committee were accompanied by Mr. E. H. Baker of Raleigh as stenographer.

The first trip was down the Cape Fear River, where the methods of catching and marketing the fish were closely observed. The fish markets of Wilmington were also inspected and information obtained regarding the size and value of fish marketed. The next stop was at Morehead City, where the fish markets were inspected. The Oyster Commissioner's boat, the *Atlantic*, carried the committee from Morehead City through Beaufort Harbor, Core Sound, and up Neuse River to New Bern, stopping en route at the Beaufort Laboratory, where the com-

mittee had an opportunity to inspect and eat some oysters taken from several of the beds that had been planted by the North Carolina Geological and Economic Survey. At the east end of Core Sound, where the night was spent, the location of natural and planted oyster bottoms were observed.

At New Bern the markets were inspected and considerable information was obtained from fishermen who brought their fish to market on that day. From New Bern to Washington the trip was made over the Norfolk Southern Railroad. At Washington the committee were met by Mr. T. S. Meekins, with the Fish Commission boat, *Gretchen*. After inspecting the fish markets at Washington, the committee was taken down Pamlico River and up Pungo River to Belhaven, where they spent Sunday. From Belhaven the committee crossed Pamlico Sound to Hatteras, having an opportunity there to study the location of nets and methods of fishing same in Hyde County and around Hatteras Inlet. The county line between Hyde and Dare counties passes through the center of Hatteras Inlet. On the Dare side the nets were set in accordance with the law, this county being under the Fish Commission, while on the Hyde County side of the line they were not. While en route from Hatteras to Manteo, Roanoke Island, the committee had a splendid opportunity to study conditions around Stumpy Point, the Ten Mile Limit, Roanoke Island, and New Inlet. The conditions in Albemarle Sound were studied while en route from Manteo to Edenton. At a number of places stops were made to enable the members of the committee to observe the methods of fishing pound and gill nets and seines. The conditions on Chowan River were also investigated.

#### *Other Meetings of Committee.*

During the latter part of the year 1911 several meetings of the committee were held in Raleigh in preparing its report. Several drafts were made and each member had an opportunity of going over these carefully. The report was finally unanimously adopted by the committee and sent to the Legislature, the report being introduced in the House by Mr. Doughton as House Bill No. 293. The bill was thoroughly discussed at joint meetings of the House and Senate committees on fish, which in turn appointed a subcommittee to draft a substitute bill that would embody the changes that the joint committees considered should be made. This bill was drafted, submitted to the members of the Legislative Fish Committee of the General Assembly of 1909 and accepted by them as a compromise bill, as it was endorsed by the Fish Committees of the House and Senate.



The following is a copy of the report made by the committee, and there is given in footnotes the sections that were changed by the joint committees, the changes being in italics:

A BILL TO BE ENTITLED "AN ACT TO ESTABLISH A FISHERIES COMMISSION AND TO PROTECT THE FISHERIES OF NORTH CAROLINA.\*

*The General Assembly of North Carolina do enact:*

SECTION 1. That for the purpose of enforcing the laws relating to all commercial fish there is hereby created a Fisheries Commission, which shall consist of a commissioner and the Geological Board and the State Geologist, which said board and said State Geologist, in addition to their duties set forth in chapter 94, section 4432, volume 2 of the Revisal of 1905, shall be clothed with the powers and charged with the duties of enforcing the provisions of this act, and for that purpose shall be denominated the Fisheries Commission Board. The commissioner shall be appointed by the Governor within thirty (30) days after the passage of this act. The commissioner shall be responsible to the Fisheries Commission Board for carrying out of the duties of his office, and shall make semiannual reports to them at such time as they may require. The term of office of said commissioner and his successors in office shall be four years, or until their successors are appointed and qualified, and in case of vacancy in the office the appointment shall be to fill the vacancy. The said commissioner shall appoint two assistant commissioners, by and with the consent of the Fisheries Commission Board, one of whom shall be designated as Assistant Fish Commissioner and the other as Shellfish Commissioner. The aforesaid commissioner and assistant commissioners shall receive such pay as the Fisheries Commission Board shall determine. During the absence of the commissioner, or his inability to act, the Fisheries Commission Board shall appoint one of the assistant commissioners to have and exercise all the powers of the commissioner. The commissioner and assistant commissioners shall each execute and file with the Secretary of State a bond payable to the State of North Carolina in the sum of five thousand dollars for the commissioner and twenty-five hundred dollars for each of the assistant commissioners, with securities to be approved by the Secretary of State, conditioned for the faithful performance of their duties and to account for and pay over pursuant to law all moneys received by them in their office. The Fisheries Commissioner and assistant commissioners shall take and subscribe an oath to support the Constitution and for the faithful performance of the duties of his office, which oaths shall be filed with their bonds. The assistant commissioners may be removed for cause by the commissioner, who may appoint their successors.<sup>1</sup>

\*House Bill No. 293, Regular Session 1911, introduced by Representative Doughton.

<sup>1</sup>The following sections were in the substitute bill for section 1 of the report of the Legislative Fish Committee:

SECTION 1. *That for the purpose of enforcing the laws relating to all commercial fish there is hereby created a Fisheries Commission, which shall consist of the State Geologist and four members appointed by the Governor from the several fishing districts of the State, who, together with the State Geologist, shall be denominated the "Fisheries Commission Board." The members shall be appointed as follows, viz.: two, whose terms of office shall expire on the first day of June, one thousand nine hundred and thirteen, and two whose terms of office shall expire on the first day of June, one*

SEC. 2. *Inspectors.*<sup>2</sup>—The Fisheries Commissioner may appoint, with the approval of the Fisheries Commission Board, inspectors in each county having fisheries under his jurisdiction, who will assist him at such times as he may require. The said inspector shall serve under the direction of the commissioner, receiving compensation not to exceed three dollars per day and necessary expenses while in actual service.

SEC. 3. *Office and Clerical Force.*<sup>2</sup>—The Fisheries Commissioner shall rent and equip an office, which will be adequate for the business of the commission, in some town conveniently located to the maritime fisheries, and he is authorized to employ such clerks and other employees as may be necessary for the proper carrying on of the work of his office, by and with the consent of the Fisheries Commission Board.

SEC. 4. *Equipment.*<sup>2</sup>—The Fisheries Commissioner is authorized, by and with the consent of the Fisheries Commission Board, to purchase or rent such boats, nets, and other equipment as may be necessary to enable him and his assistants to fulfill the duties specified in this act.

SEC. 5. *Duties.*—The commissioner shall enforce all acts relating to the fish and fisheries of North Carolina; he shall, by and with the advice and consent of the Fisheries Commission Board, make such regulations as shall maintain open for the passage of fishes all inlets and not less than one-third of the width of all sounds and streams, or such greater proportions of their width as may be necessary; he shall collect and compile statistics showing the annual product of the fisheries of the State, the capital invested and the apparatus employed, and any fisherman refusing to give these statistics shall be refused a license for the next year; and the Fish Commissioner shall prepare and have on file in his office maps based on the charts of the United

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*thousand nine hundred and fifteen; and their successors shall be appointed by the Governor for a term of four years each thereafter. The four members shall receive four dollars per day each and traveling expenses while attending meetings of the board: Provided, that the per diem and expenses shall not exceed two hundred and fifty dollars each per annum.*

*That said board shall appoint a Fish Commissioner within thirty days after the passage of this act, and the said commissioner shall be responsible to the Fisheries Commission Board for carrying out the duties of his office, and shall make semiannual reports to them at such time as they may require. The terms of office of said commissioner and his successors in office shall be four years, or until their successors are appointed and qualified; and in case of vacancy in the office, the said board shall appoint for the unexpired term of said commissioner. The Fisheries Commission Board shall appoint two assistant commissioners, one of whom shall be designated as Assistant Fish Commissioner and the other as Shellfish Commissioner. The aforesaid commissioner and assistant commissioners shall receive such pay as the said Fisheries Commission Board shall determine. During the absence of the commissioner, or in case of his inability to act, the said board shall appoint one of the assistant commissioners to have and exercise all the powers of the commissioner. The said commissioner shall execute and file with the Secretary of State a bond payable to the State of North Carolina in the sum of five thousand dollars and the two assistant commissioners shall each file a bond with the Secretary of State in the sum of twenty-five hundred dollars, conditioned for the faithful performance of their duties, and to account for and pay over pursuant to law all moneys received by them in their office. The said commissioner and assistants shall take and subscribe an oath as is required of the Fisheries Commission Board, which oath of office shall be filed with their bonds. The said commissioner and assistants may be removed from office for cause by the said Fisheries Commission Board, whose duty it shall be to appoint their successors in case of such removal.*

<sup>2</sup>These three sections same in substitute.



States Coast and Geodetic Survey, of the largest scale published, showing as closely as may be the location of all fixed apparatus employed during each fishing season; he shall have surveyed and marked in a prominent manner those areas of waters of the State in which the use of any or all fishing appliances are prohibited by law or regulation, and those areas of waters in the State in which oyster tonging or dredging is prohibited by law; he shall prosecute all violations of the fish laws, and whenever necessary he may employ counsel for this purpose; he shall seize and remove all nets or other appliances set or being used in violation of the fisheries laws of the State, advertise same for twenty days at the courthouse and three other public places, and sell same at public auction at such place as the Fisheries Commissioner shall designate, in the county in which seizure was made, and apply the proceeds of sale to payment of cost and expenses of such removal and sale, and pay any balance remaining into the State Treasury to the credit of the school fund of the county in which the seizure was made; he shall, in an official capacity, have power to administer oaths and to send for and examine persons and papers; he shall be responsible for the collection of all license fees, taxes, rentals, or other imposts on the fisheries, and shall pay same into the State Treasury to the credit of the Fisheries Commission fund; he shall, on or before the twenty-fifth day of each month, mail to the Treasurer of the State a consolidated statement showing the amount of taxes and license fees collected during the preceding month, and by and from whom collected; he shall carry on investigations relating to the migration and habits of the fish in the waters of the State, also investigations relating to the cultivation of the oyster, clam, and other mollusca, and of the terrapin, lobster, and crab, and for this purpose he may employ such scientific assistance as may be authorized by the Fisheries Commission Board.<sup>3</sup>

<sup>3</sup>This section in the substitute bill was as follows:

SEC. 5. DUTIES.—*The commissioner shall have authority to enforce all acts relating to the fish and fisheries of North Carolina; he shall by and with the advice and consent of the Fisheries Commission Board, make such regulations as shall maintain open for the passage of fishes all inlets and not less than one-third of the width of all sounds and streams; he shall collect and compile statistics showing the annual product of the fisheries of the State, the capital invested and the apparatus employed, and any fishermen refusing to give these statistics shall be refused a license for the next year; and the Fish Commissioner shall prepare and have on file in his office maps based on the charts of the United States Coast and Geodetic Survey, of the largest scale published, showing as closely as may be the location of all fixed apparatus employed during each fishing season; he shall have surveyed and marked in a prominent manner those areas of waters of the State in which the use of any or all fishing appliances are prohibited by law and those areas of water of the State in which oyster tonging or dredging is prohibited by law; he shall prosecute violations of the fish laws, and whenever necessary he may employ counsel for this purpose; he shall, in an official capacity, have power to administer oaths and to send for and examine persons and papers; he shall be responsible for the collection of all license fees, taxes, rentals, or other imposts on the fisheries, and shall pay same into the State Treasury to the credit of the Fisheries Commission fund; he shall, on or before the twenty-fifth day of each month, mail to the Treasurer of the State a consolidated statement showing the amount of taxes and license fees collected during the preceding month, and by and from whom collected; he shall carry on investigations relating to the migration and habits of the fish in the waters of the State, also investigations relating to the cultivation of the oyster, clam, and other mollusca, and of the terrapin, lobster, and crab, and for this purpose he may employ such scientific assistance as may be authorized by the Fisheries Commission Board.*

SEC. 6. *Arrests Without Warrant; When and How Made.*—The Fisheries Commissioner, assistant commissioners and inspectors, shall have power with or without warrants to arrest any person or persons violating any of the fishery laws, who shall be carried before a magistrate for trial according to section three thousand one hundred and eighty-two of the Revisal of one thousand nine hundred and five.<sup>4</sup>

SEC. 7. *Power to Take Fish.*—The Fisheries Commissioner and the United States Bureau of Fisheries may take and cause to be taken for scientific purposes, or for fish culture, any fish or other marine organism at any time from the waters of North Carolina, any law to the contrary notwithstanding; and may cause or permit to be sold such fishes or parts of fishes so taken as may not be necessary for purposes of scientific investigations or fish culture: *Provided*, that in taking fish for fish culture in the hatcheries of this State the fish shall only be taken while the hatcheries are in operation and only between the hours of 4 and 11 p. m.<sup>5</sup>

SEC. 8. *No Interest in Fisheries.*—The members of the Fisheries Commission Board, the Fisheries Commissioner, assistant commissioners and inspectors, shall not be financially interested in any fishing industry in North Carolina.<sup>6</sup>

SEC. 9. *Revenue.*—All license fees, taxes, rentals of bottoms for oyster or clam cultivation and other imposts upon the fisheries, in whatever manner collected, shall, except as otherwise provided in this act, be deposited with the State Treasurer to the credit of the Fisheries Commission fund, to be drawn upon as directed by the Fisheries Commission Board.<sup>6</sup>

SEC. 10. *License to Fish and to Catch Oysters.*—Each and every person, firm, or corporation, before commencing or engaging in any kind of fishing in the State, shall file with an inspector of the county in which he desires to fish, or with the Fisheries Commissioner, or one of his assistant commissioners, a sworn statement as to the number and kind of nets, seines, or other apparatus intended to be used in fishing. Upon filing this sworn statement on oath the Fisheries Commissioner shall issue, or cause to be issued, to the said party or parties a license as prescribed by law; said applicant shall pay a license fee equal in amount to the fee or tax prescribed by law for fishing different kinds of apparatus in the waters of the State of North Carolina, or for tonging or dredging for oysters, as the case may be. The Fisheries Commissioner shall keep in a book especially prepared for the purpose an exact record of all licenses, to whom issued, the number and kinds of nets, boats, and other apparatus licensed, and the license fees received. He shall furnish to each person, firm, or corporation in whose favor a license is issued a special tag which will show the license number and number of pound nets, or yards of seine, or yards of gill-net that the licensee is authorized to use, and the licensee shall attach said tag to the net in a conspicuous manner satisfactory to the Fisheries Commissioner. All boats or vessels licensed to scoop, scrape, or dredge oysters shall display on the port side of the jib, above the reef and bonnet and on the opposite side of mainsail, above all reef points, in black

<sup>4</sup>This section in substitute was as follows:

ARRESTS WITHOUT WARRANT; WHEN AND HOW MADE.—*The Fisheries Commissioner, assistant commissioners and inspectors, shall have power with or without warrants to arrest any person or persons in the act of violating any of the fishery laws, who shall be carried before a magistrate for trial according to section three thousand one hundred and eighty-two of the Revisal of one thousand nine hundred and five.*

<sup>5</sup>This section the same in the substitute.

<sup>6</sup>Same in substitute.



letters, not less than twenty inches long, the initial letter of the county granting the license and the number of said license, the number to be painted on canvas and furnished by the Fisheries Commissioner, for which he shall receive the sum of fifty cents. Any boat or vessel used in catching oysters without having complied with the provisions of this section may be seized, forfeited, advertised for twenty days at the courthouse and two other public places in the county where seized, and sold at some public place designated in the advertisement, and the proceeds, less the cost of the proceedings, shall be paid into the school fund. The licenses to fish with nets shall all terminate on December thirty-first. Any person who shall willfully use for commercial fishing purposes any kind of net whatever, without having first complied with the provisions of this section, shall be guilty of a misdemeanor and, upon conviction, shall be fined twenty-five dollars for each and every offense.<sup>7</sup>

SEC. 11. *License for Boat Used in Catching Oysters.*—The Fisheries Commissioner, or Shellfish Commissioner, or inspector, may grant license for a boat to be used in catching oysters upon application made, according to law, and the payment of a license tax as follows: On any boat or vessel without cabin or deck, and under custom-house tonnage, using scoops, scrapes, or dredges, measuring over all twenty-five feet and under thirty, a tax of three dollars; fifteen feet and under twenty-five feet, a tax of two dollars; on any boat or vessel with cabin or deck and under custom-house tonnage, using scrapes or dredges, measuring over all thirty feet or under, a tax of five dollars; over thirty feet, a tax of six dollars; on any boat or vessel using scoops, scrapes, or dredges required to be registered or enrolled in the custom house, a tax of one dollar and fifty cents a ton on gross tonnage. No vessel propelled by steam, gas, or electricity, and no boat or vessel not the property absolutely of a citizen or citizens of this State, shall receive license or be permitted in any manner to engage in the catching of oysters anywhere in the waters of this State.<sup>8</sup>

SEC. 12. *Fishing for Menhaden With Purse Nets.*—Whenever any person or persons, corporation or corporations, may intend to take menhaden (fat-backs), porgies, herring, or other fish in any waters within the jurisdiction of this State, including the waters of the Atlantic Ocean within three nautical miles of the coasts of said State, either on his own account and benefit or on account and benefit of his employer, with purse or shirred nets, such person or persons, corporation or corporations, shall make an application to the Fisheries Commissioner for a license, and, upon the receipt of such application, the Fisheries Commissioner shall, upon the receipt of a sum equal to two dollars for each ton of the net tonnage of each vessel employed in such fishing, said net tonnage to be determined by custom-house measurement, as a license fee, issue to such person or persons, corporation or corporations, a license duly signed by the Fisheries Commissioner, which said license shall be valid and in force for the term of one year; all such licenses to be dated from January first, and no license shall be for a space of time less than one year. For every violation of this act the offending person or persons, corporation or corporations, shall be guilty of a misdemeanor and be fined two hundred dollars for each and every offense.<sup>9</sup>

<sup>7</sup>Same in substitute, except last two lines, which read: "and upon conviction, shall be fined not less than five dollars nor more than fifty dollars for each and every offense."

<sup>8</sup>These sections 11 and 12 are the same in the substitute, except that the license tax is in each case one dollar less.

SEC. 13. *Purchase Tax.*—All dealers in oysters and all persons who purchase oysters for canning, packing, shucking, or shipping, shall pay a tax of two cents on every bushel of oysters purchased by them, or caught by them, or by any one for them: *Provided*, that no oyster shall be twice taxed. This tax shall be paid to and collected by the inspectors, and, when paid, a receipt shall be given therefor. Upon failure or refusal by any person, firm, or corporation to pay said tax, his license as a dealer shall at once become null and void, and no further license shall be granted him during the current year; and it shall be the duty of the commissioner, assistant commissioner, or inspector to institute suit for the collection of said tax. Such suit shall be in the name of the State of North Carolina on relation of the commissioner or of the inspector at whose instance such suit is instituted, and the recovery shall be for the benefit and to the use of the general Fisheries Commission fund.<sup>9</sup>

SEC. 14. *License Tax.*—The following license tax is hereby levied annually upon the different fishing appliances used in the waters of North Carolina:

Anchor gill-nets, twenty cents per one hundred yards or fraction thereof.

Stake gill-nets, ten cents per one hundred yards or fraction thereof.

Drift gill-nets, twenty cents per one hundred yards or fraction thereof.

Pound-nets, one dollar each.

Seine, drag-nets, and mullet nets under one hundred yards, one dollar each.

Seine, drag-nets, and mullet nets over one hundred yards and under three hundred yards, one dollar per one hundred yards or fraction thereof.

Seine, drag-nets, and mullet nets over three hundred yards and under one thousand yards, one dollar and twenty-five cents per one hundred yards or fraction thereof.

Seine, drag-nets, and mullet nets over one thousand yards, one dollar and seventy-five cents per one hundred yards or fraction thereof.

Fyke-nets, twenty-five cents each.

Tonging for oysters, the license tax shall be one dollar for each tonger.<sup>10</sup>

<sup>9</sup>This section in the substitute is as follows:

PURCHASE TAX. *All dealers in oysters, and all persons who purchase oysters for canning, packing, shucking, or shipping, shall pay a tax of two cents on every bushel of oysters purchased by them, or caught by them, or by any one for them, except coon oysters, which shall be taxed one cent per bushel: Provided, that no oyster shall be twice taxed. This tax shall be paid to and collected by the inspectors, and, when paid, a receipt shall be given therefor. Upon failure or refusal by any person, firm, or corporation to pay said tax, his license as a dealer shall at once become null and void, and no further license shall be granted him during the current year; and it shall be the duty of the commissioner, assistant commissioner, or inspector to institute suit for the collection of said tax. Such suit shall be in the name of the State of North Carolina on relation of the commissioner or of the inspector at whose instance such suit is instituted, and the recovery shall be for the benefit and to the use of the general Fisheries Commission fund.*

<sup>10</sup>LICENSE TAX. *The following license tax is hereby levied annually upon the different fishing appliances used in the waters of North Carolina:*

*Anchor gill-nets, twenty cents per hundred yards or fraction thereof.*

*Stake gill-nets, ten cents per hundred yards or fraction thereof for all nets in excess of three hundred yards.*

*Drift gill-nets, twenty cents per hundred yards or fraction thereof.*

*Pound-nets, one dollar each.*

*Seine, drag-nets, and mullet nets over three hundred yards and under one thousand yards, one dollar per hundred yards or fraction thereof.*

*Seine, drag-nets, and mullet nets over one thousand yards, one dollar and fifty cents per hundred yards or fraction thereof.*



SEC. 15. *Reports.*—The Fisheries Commission Board shall cause to be prepared and submitted to each Legislature a report showing the operations, collections, and expenditures of the Fisheries Commission; it shall also cause to be prepared for publication such other reports, with necessary illustrations and maps, as will adequately set forth the results of the work and the investigations of the Fisheries Commission, all such reports, illustrations, and maps to be printed and distributed at the expense of the State, as are other public documents, as the Fisheries Commission Board may direct.<sup>11</sup>

SEC. 16. *Appropriation.*—There is hereby appropriated out of the General Treasury as a supplementary fund the sum of ten thousand dollars annually for four years, or as much thereof as may be needed, to the Fisheries Commission to carry out the work of the commission in the protection and promotion of the fisheries of the State, this sum to be repaid to the General Treasury by the Fisheries Commission when it shall be on a self-sustaining basis, said sum to be used and expended as directed by the Fisheries Commission Board, and any part of it that may be required may be used for purchasing boats and other equipment necessary to carry out the work of the commission; and any money that may be in the State Treasury to the credit of the Fish Commission and Oyster Commission fund on the day that this act becomes effective shall be transferred by the State Treasurer to the credit of the Fisheries Commission fund, and the Fisheries Commission Board is hereby authorized to pay out of the Fisheries Commission fund all just claims that may be outstanding against the Fish or Oyster Commissions.<sup>11</sup>

SEC. 17. *Transfer of Equipment.*—All boats, fishing and oyster tackle, office supplies, stationery, and all other supplies of whatever character belonging to the Fish Commission and Oyster Commission shall be transferred to the Fisheries Commissioner for the use of the Fisheries Commission.<sup>11</sup>

SEC. 18. *Jurisdiction of State.*—The State of North Carolina shall have exclusive jurisdiction and control over all the commercial fisheries of the State wherever located.<sup>11</sup>

SEC. 19. It shall be unlawful to place in any of the waters of this State any dynamite, giant or electric powder, or any explosive substance whatever, or any drug or poisoned bait, for the purpose of taking, killing, or injuring fish. And any one violating this section shall be guilty of a misdemeanor and shall, upon conviction, be fined or imprisoned in the discretion of the court.<sup>11</sup>

SEC. 20. It shall be unlawful to discharge or to cause or permit to be discharged into the waters of the State any deleterious or poisonous substance or

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*Fyke-nets, twenty-five cents each.*

*Tonging for oysters, the license tax shall be one dollar for each tonger.*

*Any person who shall engage in fishing with any of the above-named nets or appliances for commercial purposes, without first procuring the license therefor, shall be guilty of a misdemeanor, and upon conviction shall be fined not more than fifty dollars or imprisoned not more than thirty days.*

*That any person desiring to engage in the business of purchasing fish for shipment and not for retailing shall first procure a license from the Fisheries Commission Board, for which a charge of ten dollars shall be paid, and said dealer shall keep a true account of all amounts paid for fish to be supplied, and shall make a verified statement at the end of each month of the total amount bought, and shall remit to the Fisheries Commission Board with said monthly report a tax at the rate of one dollar per one thousand dollars in such purchases made by him: Provided, that a second tax on purchases shall not be paid. Any dealer failing to procure license, or any dealer failing to make true and accurate statement of purchases, as required, shall upon conviction be guilty of a misdemeanor, and his license shall be revoked for one year.*

substances inimical to the fishes inhabiting the said waters; and any person, persons, or corporation violating the provisions of this section shall be guilty of a misdemeanor and, upon conviction, be fined or imprisoned in the discretion of the court.<sup>11</sup>

SEC. 21. The Fisheries Commission Board is hereby authorized to regulate, prohibit, or restrict, in time, place, character, and dimensions, the use of nets, appliances, apparatus, or means employed in taking or killing fish; to regulate the seasons at which the various species of fish may be taken in the several waters of the State, and to prescribe the minimum sizes of fish which may be taken in the said several waters of the State; and such regulations, prohibitions, restrictions, and prescriptions, after due publication, shall be of equal force and effect with the provisions of this act; and any person violating the provisions of this section shall be guilty of a misdemeanor, and upon conviction shall be fined or imprisoned at the discretion of the court: *Provided, however*, that if a petition signed by five or more voters of the district or community which will be affected by the proposed change is filed with the Fisheries Commission Board through the Fisheries Commissioner, assistant commissioners, or inspectors, asking that they have a hearing before any proposed change in the territory, size of mesh, length of net, or time of fishing shall go into effect, petitioning that they be heard regarding said change, the Fisheries Commission Board shall in that event designate by advertisement for a period of thirty days at the courthouse and three other public places in the county affected, and also by publication in a newspaper of the county, if such is published in said county, for two consecutive weeks, a place at which said board will meet and hear argument for and against said change, and may ratify, rescind, or alter this previous order of change as may seem just in the premises.<sup>12</sup>

SEC. 22. Any person or persons removing, injuring, defacing, or in any way disturbing the posts, buoys, or any other appliances used by the Fisheries Commission in marking the restricted areas relating to any and all fishing, or marking other areas in which oyster tonging or dredging is prohibited by law, and those marking oyster bottoms that are leased for oyster cultivation, shall be guilty of a misdemeanor and, upon conviction, shall be fined or imprisoned at the discretion of the court.<sup>13</sup>

SEC. 23. Wherever the word fish or fishes used as a substantive occurs in this act it shall be construed to include porpoises and other marine mammals, fishes, mollusca, and crustaceans, and wherever the word fishing or fisheries occurs it shall be construed to include all operations involved in using, setting, or operating apparatus employed in killing or taking the said animals or in transporting and preparing them for market.<sup>13</sup>

<sup>11</sup>This section is the same in substitute.

<sup>12</sup>This section was left out of the substitute bill, but the following was added as a new section:

*That it shall be unlawful for any person, firm, or corporation in this State to catch for market or compost, ship, buy or sell, or to have in his possession for sale, any mullet of less than eight inches in length; any trout, bluefish or tailor, drum, sea-mullet, or kingfish, flounder, mackerel, or rock of less than nine inches in length; or any spots, hogfish, or croakers of less than six inches in length; any butterfish or starfish less than five inches in length. That any person, firm, or corporation violating the provisions of this section shall be guilty of a misdemeanor, and upon conviction or confession shall be fined not more than fifty dollars or imprisoned not more than thirty days.*

<sup>13</sup>This section the same in substitute.



SEC. 24. That all acts relating to the commercial fisheries of North Carolina are hereby amended so that the words "Shellfish Commissioner," "Oyster Commissioner," or "Fish Commissioner" shall read "*Fisheries Commissioner*"; and the words "Shellfish Commission," "Oyster Commission," or "Fish Commission" shall read "*Fisheries Commission*."<sup>13</sup>

SEC. 25. All laws and clauses of laws in conflict with this act are hereby repealed.<sup>13</sup>

SEC. 26. That this act shall be in force from and after its ratification.<sup>14</sup>

It will be interesting at this time to give the opinion of the United States Bureau of Fisheries on the report of the committee, and this opinion was made a part of the report to the General Assembly of 1911:

## DEPARTMENT OF COMMERCE AND LABOR

### BUREAU OF FISHERIES

WASHINGTON

November 28, 1910.

DR. JOSEPH HYDE PRATT, *State Geologist*,  
*Chapel Hill, N. C.*

SIR:—The Bureau acknowledges the receipt of your letter of November 15, submitting for criticism the report of the joint legislative committee on fishery matters which will be transmitted to the North Carolina Legislature of 1911. The Bureau has examined the proposed laws with care, and is pleased to observe that they have both the breadth and flexibility essential to meet the conditions obtaining in North Carolina. The provision for a single commissioner accountable to a board already established, and which has demonstrated its efficiency in connection with the Geological Survey, is regarded as excellent. It centralizes the administration of the fisheries regulations, while at the same time placing at the service of the commissioner the advice, and, if need be, the control, of a body free from bias and local association with the fishing communities.

Safeguarded by this provision, the commissioner properly is given a wide discretion concerning the details of the regulations. While the broad principle of State control of the fisheries is in the opinion of the Bureau the only plan that will prove of lasting value, it is essential that recognition be made of the fact that identical regulations as to nets, close seasons, etc., are not applicable to all localities. After some experience and investigation the commissioner will be in an unequaled position to recommend such regulations as will meet the local requirements and conditions. In respect to this, the Bureau believes that the proposed law is superior to the systems applied in other States and equal to that which has demonstrated its efficiency in the Dominion of Canada. The Bureau is pleased also that there is proposed statutory recognition of the principle of an open channel for the access of fish to the upper waters. The success of the application of this principle to the upper sounds

<sup>13</sup>This section read as follows in the substitute:

*That this act shall be in force from and after June first, one thousand nine hundred and eleven.*

of North Carolina has been attested by an improvement in the fishery and in the increase of the take of shad eggs at Edenton hatchery from six and a half millions in 1905 to seventy millions in 1910.

The oyster regulations do not appear to be materially changed, but the consolidation of the oyster commission with the fishery commission is in the interest of economy and efficiency of administration.

The Bureau feels that it can properly endorse the conclusions of the committee, and expresses the hope that they may be enacted into law for the benefit of not only the fishing communities, but the State of North Carolina as a whole.

Respectfully,

H. M. SMITH,

*Acting Commissioner.*

The bill carried an appropriation, and was reported favorably by the committee on appropriations.

This substitute bill, after considerable debate, passed the House without amendment; but when it came up in the Senate it was so amended that it did not apply to certain counties, and after the amendments were passed the bill was defeated.

To satisfy a very few, and out of *senatorial courtesy*, a State-wide bill was allowed to be defeated, and a large and important State industry was permitted not only to be retarded in its growth, but to actually decline. It was a severe blow to the fishing industry of North Carolina; but those who have the interest of the State of North Carolina at heart and are thoroughly familiar with the dangers that beset this industry are harder at work than ever to create a sentiment for the protection and perpetuation of fishing industries. They realize that they must carry on a campaign of education; that the fishermen must be given accurate information as to what the protection of these industries will mean to them, and that the measures advocated are absolutely necessary if they and their children are to continue to make a livelihood out of fishing; and the citizens, indeed, must have the information that will show them that the fish and oysters are decreasing; that the industries are growing less and less, and what could be made a most flourishing industry in the State is becoming less and less every year; that what is a State industry and a State problem has been considered purely as a local problem; that an asset which belongs to all the people is being destroyed by a few.

North Carolina, with its great extent of salt and fresh waters, should be near the top of the list of the Atlantic States in value of its fish industry. Instead it stands eleventh. Massachusetts is first, Virginia second, Maryland fifth, and even little Connecticut comes ninth.

We can build up this industry if we will carry out similar measures to those that other States have carried out.



The *New Bern Journal*, in discussing this question, says:

"There is a chance to revive this business, to make the fishing industry of North Carolina a profitable and permanent one; but it will not come through the political methods which have been pursued. The demand is for a State Fish Commission that is beyond politics, that will be practical, unbiased and honest; that will place all counties under one general law, place the fishermen upon equal terms, and see to it that the fish are protected, caught when marketable and kept from destruction when not marketable.

"North Carolina's fish and oyster industries call for rational and business-like treatment, removed from politics, and when they are, it means many thousands of dollars to the people of this section where none are received to-day. The Fisheries Committee are on the right track, and its report before the next Legislature will be all-important to Eastern Carolina."

It is possible to protect and perpetuate our fish and oyster industries by the enactment and enforcement of adequate laws. It seems to be the consensus of opinion of those who have made a thorough study of the fish industries, that the only method of enforcing the laws regulating fishing and of fostering this industry is through the operation of the Fish Commission. The work of such a commission goes beyond that of simply enforcing the laws; it should carry on investigations relating to the various fishing industries; study local conditions, and be able to render a just decision regarding what is the best thing to be done in relation to the perpetuation of the oyster and any type of fish to the best interests of the State. As has been stated before, up to the present time these questions have been considered locally, while they should be considered a State question, and the best results can only be obtained when they are thus considered.

As the oyster industry in North Carolina is practically dependent upon the cultivation of the oyster, there is given below a short paper on the cultivation of the oyster in North Carolina, which gives briefly a history of the work that has been done along this line, together with the possibilities that are open to those who take up the cultivation of the oyster as a business.

#### CULTIVATION OF THE OYSTER IN NORTH CAROLINA.

One of the most important problems that confronts North Carolina at the present time, in connection with the development of its fisheries, is that relating to the cultivation of the oyster. Not only is the cultivation of the oyster necessary in order to increase the oyster industry of the State, but the life of the industry itself and the preservation of the natural oyster rocks are dependent upon the cultivation of the oyster in the waters of this State.

Personally, I know but little regarding oyster culture; but, as head of the Department in North Carolina which has been authorized by the Legislature to have made thorough and exhaustive investigations in regard to the fishing industries of the State, we have had considerable work done on questions relating to oyster culture. For this work we have very fortunately been able to obtain the services of men who were qualified to take up the investigations which the State Geological Survey desired to have made, the first investigations having been made by Dr. Caswell Grave and the later ones by Dr. Robert E. Coker. To these investigations the Survey is very much indebted for their very able and conscientious work on the problems relating to oyster culture.

Dr. Grave's work was confined principally to the waters in the vicinity of Beaufort, North Carolina, and the plants that he made were in Newport and North rivers. With the assistance of the steamer *Fish Hawk*, of the United States Bureau of Fisheries, Dr. Grave also made some investigations relating to the condition of the natural oyster rocks in Pamlico Sound and tributaries, and collected considerable information regarding the salinity of the water, the food supply for the oyster, and the direction and velocity of the currents. The results of Dr. Grave's experiments were satisfactory, although both in a negative and a positive way he states:

"Several important facts have been demonstrated which cannot fail to have a bearing upon any future operations in oyster culture in North Carolina. The lower parts of Newport and North rivers are not adapted to oyster culture. Oysters grow there in abundance when supported above the mud, but there is too much uncertainty connected with the crop to justify practical planting operations. When the time comes to place the oysters on the market they are too often not in salable condition. This is traceable to the high density of the water of these portions of the rivers. Should the industry in Pamlico Sound ever be developed to such an extent as to create a demand for seed oysters, however, the ground in the lower parts of these rivers will become valuable, for when cultch is exposed a good catch of spat is almost a certainty.

"The upper parts of the rivers, on the other hand, are well adapted to oyster planting, and, during all but the very dry seasons, there is every reason to believe that planters would be able to market their crop. The industry could never be extensive on account of the small amount of available ground, but between the natural beds there are many acres that might be utilized for purposes of planting. The natural beds themselves, if strewn with shells at some time during the summer months, could easily be made to yield many times the amount of oysters that is annually taken from them. They are public property, and no individual can be expected to be so public spirited as to plant the shells, but it might be done by the State, in one instance at least, as an experiment."

This work of Dr. Grave on oyster culture was begun in April, 1900, and extended over a period of about three years. As is seen from the



statement made above, these experiments showed that a marketable oyster (except for seed) could not be grown in the lower waters of either Newport or North rivers, but that the upper waters of both these rivers were very favorable for oyster culture. As, however, there was practically no demand for seed oysters, and as the areas in the upper portion of the rivers available for oyster culture were very limited, there was but very little advance made in oyster culture in North Carolina as a direct result of this work. If the work of the Survey on oyster culture had ceased with the experiments of Dr. Grave, we would have been of no great assistance to the oyster culturists in this State. Dr. Grave, however, had called attention to the need of carrying on experiments in Pamlico Sound, and that if the waters and bottoms were suitable for oyster culture, there would be large areas available for this purpose.

On account of the success of Dr. Grave's work in Newport and North rivers, it was deemed advisable to try larger plants and the greater variety of bottoms which were offered by Pamlico Sound. These investigations were made by Dr. Robert E. Coker, and the results, as a whole, were very satisfactory. Experimental plants were made on different bottoms in the various localities, in order to ascertain by actual trial what methods best suited particular regions or bottoms; and these beds were visited at intervals of a few months for the purpose of collecting data regarding the set of spats, rate of growth, density of water, and other biological and physical conditions. These beds were kept under observation fairly regularly for a period of four years, and proved rather conclusively that there are large areas in Pamlico Sound that are suitable for the cultivation of the oyster, and that this can be done profitably.

Oyster culture is not a new idea in North Carolina, for as early as 1840 oyster culture had been carried on in a small way for private purposes, but it was not until 1884 that there was any special attempt made to take up oyster culture commercially; and this was due to the passage of an act by the Legislature of 1883 which authorized the taking up of bottoms (except those in Pamlico Sound) for private cultivation of the oyster. There was little or no success attending the efforts of those who took out grants for oyster bottoms, and within a couple of years there were but very few acres under cultivation. In 1887-88 a survey, known as the Winslow Survey, was made of Pamlico Sound and tributaries which was supposed to show the location of the natural oyster rocks, and the bottoms not included within the boundary of the survey were supposed to be free from oyster rocks and open for lease for the purposes of oyster culture. Many thousands of acres of the bottoms of Pamlico

Sound and tributaries were taken up, and it looked as though oyster culture in North Carolina would be placed upon a firm foundation. Owing to one cause or another, however, which will be discussed later, the efforts of the planters were almost complete failures, and the cause of oyster culture in this State received a setback from which it is only just recovering.

Many people have believed that certain of the bottoms of Pamlico and Core sounds and their tributaries were favorable locations for oyster culture, but this had not been definitely proved until the experiments and investigations that were carried on by Drs. Grave and Coker had yielded results. Without knowing the conditions as they existed in eastern North Carolina, one would have supposed that after the results of these investigations had been published that oyster cultivation would have begun on a large scale. The reason that this was not done was that the people have not forgotten the losses that were sustained between 1880 and 1895. It might be well to discuss briefly the main reasons why the planters were not successful in cultivating the oyster during this period. In the first place, those who started to cultivate the oyster on a commercial scale did not make a thorough examination of the bottoms where they made their plants, and in many instances made no examination whatever as to the suitability of the locality for oyster culture. They simply took out a grant for a certain number of acres, and dumped a certain number of bushels of oyster shells, or, in some cases, seed oysters on these bottoms, and expected that nature would build up for them within a short time a profitable oyster rock. Others took out grants for large areas of bottoms in Pamlico Sound, not for the purpose of oyster cultivation, but for the purpose of speculation, expecting to resell their grants at a large profit. This latter set of men, in reselling or releasing their grants, called them oyster bottoms, and some of those purchasing the same took it for granted that they were obtaining suitable bottoms for oyster culture, but which they found out later were not in any way adapted to this purpose. The losses sustained by these men, though not very large individually, amounted to a considerable sum in the aggregate, and each one who did lose became a bitter opponent to oyster culture; though, in most cases, their loss was due to the fact that they had not selected suitable bottoms for planting, nor done their planting in a thorough manner.

Others, who desired to cultivate the oyster, made a thorough study of the question, took out grants on bottoms that were suitable for this purpose, planted shells or seed oysters in the most approved manner, and got beds started that began to yield very abundantly. They were not, however, allowed to reap the benefit of their labor, inasmuch as the



law governing oyster culture was not adequate to protect them. All that was necessary to cause these bottoms, which had been successfully cultivated, to revert back to the State was for two or more witnesses to appear before the court and swear that these bottoms had contained oysters before cultivation had begun, and that oystermen in that vicinity were accustomed to take oysters off of them. Thus, when the oyster culturist attempted to obtain a verdict against any one for obtaining oysters off of his cultivated beds, he found that the verdict was always against him instead of for him, and as a result of this verdict his bed was declared a natural rock, and, therefore, a public oyster ground. This continued year after year, and by 1900 practically all of the cultivated beds had been abandoned, except a very few acres that are still being cultivated for private use.

Thus, the North Carolina Geological and Economic Survey had two problems to solve: first, whether the cultivation of the oyster in the waters of Pamlico and Core sounds and their tributaries was practicable on a commercial scale; and also whether it was possible to obtain the passage of adequate laws to protect the cultivator of the oyster in his rights to the bottoms which he leased.

The first of these problems was solved before taking up the second, and, as has been indicated above, it has been solved satisfactorily and proved that oyster culture could be carried on profitably over large areas of the waters of eastern North Carolina. The Survey then took up the question of adequate legislation for the protection of the oyster culturist, and we believe that we are finally reaching a satisfactory solution of this problem. The Legislature of 1909 passed a law relating to the oyster, a copy of which is given below.

#### LEGISLATION RELATING TO THE CULTIVATION OF THE OYSTER.

**SECTION 1. *Shellfish Commissioner can lease bottoms.***—The Shellfish Commissioner shall have power to lease to any duly qualified person, firm, or corporation, for purposes of oyster culture, any bottom of the waters of the State not a natural oyster bed as defined in this act, in accordance with the provisions of this law.

**SEC. 2. *Leasing of bottoms.***—Any citizen of North Carolina or firm or corporation organized under the laws of the State and doing business within its limits shall be granted the privilege of taking up bottoms for purposes of oyster culture, under the provisions of this act, of an area not less than one acre nor more than fifty acres, with the exception of the open waters of Pamlico Sound (and for the purposes of this act open waters of Pamlico Sound shall mean the waters that are outside of two miles of the shore line), in which the minimum limit shall be five acres and the maximum shall be two hundred acres: *Provided*, that the limit of entry in Core Sound, North River, Newport River, Bogue Sound, and all bays and creeks bordering on these

waters, and in Jones Bay, Rose Bay, Abels Bay, Swan Quarter Bay, Middle Bay, Bay River, Deep Bay, Juniper, West and East Bluff bays, Wyesocking Bay, Fire Creek, Stumpy Point Bay, Mouse Harbor Bay, Maw Bay, and Broad Creek tributaries of Pamlico Sound, shall be one acre as a minimum and ten acres as a maximum: *Provided further*, however, that at the end of one year from the passage of this act that the minimum area in Core Sound, North River, Newport River, Bogue Sound, and all bays and creeks bordering on these waters, and in Jones Bay, Rose Bay, Abels Bay, Swan Quarter Bay, Middle Bay, Bay River, Deep Bay, Juniper Bay, West and East Bluff bays, Wyesocking Bay, Fire Creek, Stumpy Point, Mouse Harbor Bay, and Maw Bay, and Broad Creek tributaries of Pamlico Sound, shall be one acre and the maximum fifty acres; but no person, firm, corporation, or association shall severally or collectively hold any interest in any lease or leases aggregating an area of greater than fifty acres, except in the open waters of Pamlico Sound, where the aggregate area shall be two hundred acres.

SEC. 3. *Lease, how obtained.*—Such persons, firms, or corporations desiring to avail themselves of the privileges of this act shall make written application on a form to be prepared by the Shellfish Commissioner, setting forth the name and address of the applicant, describing as definitely as may be the location and extent of the bottom for which application is made, and requesting the survey of and leasing to the applicant of said bottom. As soon as possible after the application is received the Shellfish Commissioner shall cause to be made a survey and map of said bottom at the expense of the applicant. The Shellfish Commissioner shall also thoroughly examine said bottoms by sounding and by dragging thereover a chain to detect the presence of natural oysters. Should any natural oysters be found, the commissioner shall cause examination to be made to ascertain the area and density of oysters on said bottom or bed to determine whether the same is a natural bed under the definition contained in this act. He shall be assisted in this examination on tonging ground by an expert tonger to be appointed by the board of county commissioners of the county in which said bottom or the greater portion thereof is located, and the question as to whether the oyster growth is sufficiently dense to fall within the definition of the natural bed shall be determined by the quantity of oysters which the said expert tonger may be able to take in a specified time; and on dredging ground the commissioner shall be assisted by an expert dredger, appointed by the board of county commissioners of the county in which said bottom or the greater portion thereof is located, and the question as to whether the oyster growth is sufficiently dense to fall within the definition of the natural bed shall be determined by the quantity of oysters which the said expert dredger may be able to take in a specified time. The Shellfish Commissioner shall require the bodies of bottoms applied for to be as compact as possible, taking into consideration the shape of the body of water and the consistency of the bottom. No application shall be entertained nor lease granted for a piece of bottom within two hundred yards of a known natural bottom, bed, or reef. A deposit of ten dollars will be required of each applicant at the time of making his application, said sum to be credited to the cost of the survey of the bottom applied for.

SEC. 4. *Marking and staking of leased bottoms.*—Immediately upon the completion of the survey and the mapping thereof and the payment by the applicant of the cost of said survey and map, the Shellfish Commissioner shall



execute to the applicant, upon a form approved by the Attorney-General of the State, a lease for the bottoms applied for. A copy of the lease, map of the survey, and a description of the bottom, defining its position, shall be filed in the office of the Shellfish Commissioner. After the execution of said lease, the lessee shall have the sole right and use of said bottoms, and all shells, oysters, and culch thereon, or placed thereon, shall be his exclusive property so long as he complies with the provisions of this law. The lessee shall stake off and mark the bottoms leased in the manner prescribed by the Shellfish Commissioner, and failure so to do within a period of thirty days of an order so to do issued by the commissioner shall subject said lessee to a fine of five dollars per acre for each sixty days default in compliance with said order. The corner stakes, at least, of each lease shall be marked with signs plainly displaying the number of the lease and the name of the lessee. The lessee shall within two years of the commencement of his lease have planted upon his holdings a quantity of shells equal to an average of fifty bushels of seed oysters or shells per acre of holdings, and within four years from the commencement of his lease a quantity of oysters or shells equal to an average of not less than one hundred and twenty-five bushels per acre. The Oyster Commissioner shall, upon granting any lease, publish a notice of the granting of same in a newspaper of general circulation in the county wherein the bottom leased is located.

SEC. 5. *Term of lease, rental.*—All leases made under the provisions of this act shall begin upon the issuance of the lease and shall expire on the first day of April of the twentieth year thereafter. The rental shall be at the rate of one dollar per acre per year for the first ten years and two dollars per acre per year for the next ten years of the lease, payable annually in advance on the first day of April of each year: *Provided*, that in the open waters of Pamlico Sound—and for the purposes of this act the open waters of Pamlico Sound shall mean the waters that are outside the two miles of the shore line—the rental shall be at the rate of fifty cents per acre per year for the first three years; one dollar per acre per year for the next seven years; and two dollars per acre per year for the next ten years of the lease. This rental shall be in lieu of all other taxes and imposts whatever and shall be considered as all and the only taxation which can be imposed by the State, counties, municipalities, or other subordinate political bodies. The rental for the first year shall be paid in advance to an amount proportional to the unexpired part of the year to the first of April next succeeding.

SEC. 6. *Transfer of lease, inheritance of lease.*—The said lease shall be heritable and transferable, in whole or in part, provided the qualifications of the heirs and transferees are such as are described by this act. Nonresidents acquiring by inheritance or process sale, or persons already holding the maximum area permitted by this act, shall within a period of twelve months from time of acquisition dispose of said prohibited or excess of holding to some qualified person, firm, or corporation, under penalty of forfeiture. The lease shall be subject to mortgage, pledge, seizure for debt, and the same other transactions as are other property rights in North Carolina. No transfer shall be of effect, unless of court record, until entered on the books of the Shellfish Commissioner.

SEC. 7. *Releasing of bottoms.*—The term of each lease granted under the provisions of this act shall be for a period of twenty years from the first

day of April preceding the date of granting of said lease. At the expiration of the first lease the lessee, upon making written application on the prescribed form, shall be entitled to successive leases on the same terms as applied to the last ten years of the first lease, for a period not exceeding ten years each.

SEC. 8. *Forfeiture of lease.*—The failure to pay the rental of bottoms leased for each year in advance on or before the first day of April or within thirty days thereafter shall *ipso facto* cancel said lease and shall forfeit to the State the said leased bottoms and all oysters thereon, and upon said forfeiture the Shellfish Commissioner is hereby authorized to lease the said bottoms to any qualified applicant therefor: *Provided*, that no forfeiture shall be valid, however, under the provisions of this section unless there shall have been mailed by the Shellfish Commissioner to the last address of the lessee upon the books of the commissioner a thirty days notice of the maturity of said rental.

SEC. 9. *Title secure.*—If any person within four months of the publication of the notice of granting of any lease makes claim that a natural oyster bottom, bed, or reef exists within the boundaries of said lease, he shall under oath state his claim and request the Shellfish Commissioner to cancel said lease: *Provided, however*, that each such claim and petition shall be accompanied by a deposit of twenty-five dollars. No petition unaccompanied by said deposit shall be considered by the commissioner. The Shellfish Commissioner shall in person examine into said claim, and if the decision should be against the claimant, the deposit of twenty-five dollars shall be forfeited to the State and deposited to the credit of the Shellfish Commission fund. Should, however, the claim be sustained and a natural bed be found within the boundary of the lease, the said natural bed shall be surveyed and marked with stakes or buoys at the expense of the lessee, and the said natural bed be thrown open to the public fishery. If no such claim be presented within a period of four months, or if when so presented it fail of substantiation as provided, the lessee shall thereafter be secure from attack on such account and his lease shall be incontestable so long as he complies with the other provisions of this act. In each and every such case the decision of the Shellfish Commissioner shall be subject to review and appeal before a judge of the Superior Court, who shall render a decision without the aid of a jury, and his decision shall be final.

While this law is not sufficient to begin the building up of an Oyster Cultivation Industry in North Carolina, yet we believe it is a start in the right direction; and, with the passage of favorable legislation at the Legislature of 1913, it is believed that oyster culture will begin on a considerable scale in this State. The old laws relating to the obtaining of grants to bottoms of Pamlico and Core sounds for the cultivation of the oyster were not repealed; so that at the present time we have three methods for taking up bottoms for oyster culture.

A certain amount of educational work has been attempted amongst the oystermen, to show them that an increase in the oyster industry in North Carolina and even its perpetuation is absolutely dependent upon oyster cultivation; that it will mean the renewal of many of the almost



depleted natural rocks, and that it will create a better market for all North Carolina oysters, and thus put the industry on a firm basis. At the present time the catch of oysters in North Carolina has been decreasing very rapidly, as shown by the following table of the catch of oysters for the past ten years:

No. of bushels taken in 1887.....	100,000 (cir.)
No. of bushels taken in 1890.....	2,700,000 (estimated)
No. of bushels taken in 1893-94.....	60,000
No. of bushels taken in 1896-97.....	40,000

This decline followed the exclusion of Maryland, Virginia, Delaware, and New Jersey vessels that made the large part of the catch of 1890.

No. of bushels taken in 1897.....	858,816	} From the territory under the jurisdiction of the State Oyster Commission.
No. of bushels taken in 1898-99.....	2,450,000	
No. of bushels taken in 1899-00.....	1,900,000	
No. of bushels taken in 1901-02.....	693,516	
No. of bushels taken in 1902-03.....	658,769	
No. of bushels taken in 1903-04.....	505,141	
No. of bushels taken in 1904-05.....	459,485	}
No. of bushels taken in 1905-06.....	291,846	

As is noted from the above table, the catch of oysters in 1890 was 2,700,000 bushels, and was due to the oyster vessels from Maryland, Virginia, Delaware, and New Jersey, that came down into North Carolina waters for oysters, not only buying, but also dredging. This caused a large falling off in the catch of oysters for the next few years; but in '97 it again began to increase—due partly to a demand for North Carolina oysters from packers in Virginia—and a great many North Carolina oysters were shipped to Virginia and Maryland, for packing and also for planting. They were all sold, however, as Chesapeake oysters. From 1898 to the present time there has been a steady decline in the catch of oysters, and during the past year it was under 300,000 bushels.

When we stop to consider that Pamlico Sound is as large as Long Island Sound, where over 80,000 acres are under cultivation, and something like half as large as Chesapeake Bay, where oyster cultivation has only recently been started—there are over 13,000 acres of bottom held for cultivation in the State of Virginia alone—it is seen that the possibilities of oyster culture in this State are very large.

It is of interest to note that the oyster beds referred to above as having been planted by Drs. Grave and Coker were visited in March, 1910, after a lapse of three years. It was not possible to definitely locate all the beds, but some of those in Newport River and Chain Shot Shoal, Harbor Island, and Pain's Bay were located, and oysters taken off of

the beds and examined. It was found that these beds had been pretty thoroughly tonged by the oystermen of the vicinity, which shows that the plants had continued to grow and become apparently permanent rocks. Many of the beds had been regularly worked by the oystermen for the past three years. The oysters were of good shape and quality, and from some of the beds would make good shell stock.

The income that the State may derive from its leased oyster bottoms is problematic, but the industry can be largely increased and put on a self-supporting basis. Rhode Island received in 1909 something over \$105,000 rental from its oyster ground, and Virginia about \$50,000. North Carolina's area of oyster ground suitable for the cultivation of the oyster is large and the State should receive a large amount for the lease of these grounds.

As a final comparison of the oyster industry in four of the Southern States, the following statistics are given of the catch of oysters in Maryland, Virginia, North Carolina, and Louisiana during the season 1910-1911:

State.	Catch of Oysters, 1910-11.	
	<i>Bushels.</i>	<i>Value.</i>
Maryland .....	3,500,000	\$.....
Virginia .....		3,500,000
North Carolina .....	121,219	24,243
Louisiana .....	1,966,677	1,311,118



PUBLICATIONS  
OF THE  
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Lancy in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Water-powers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*

## ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a List of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virginina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestone; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*



Administrative report.

[illegible]

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp.  
*Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp.  
*Postage 2 cents.*

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp.  
*Postage 2 cents.*

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp.  
*Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp.  
*Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract; Buncombe County, Transylvania County State Farm, certain Watersheds, Reforestation of Cut-over and Abandoned Farm Lands, on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a letter should accompany sample and stamp should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of postage needed, as indicated above, for mailing the bulletins desired, to the State Geologist, Chapel Hill, N. C.



**NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY**

JOSEPH HYDE PRATT, State Geologist

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**ECONOMIC PAPER No. 25**

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**PROCEEDINGS**

OF

**SECOND ANNUAL CONVENTION**

OF THE

**NORTH CAROLINA FORESTRY ASSOCIATION**

HELD AT

**RALEIGH, NORTH CAROLINA**

**February 21, 1912**

COMPILED BY

**J. S. HOLMES, Forester**

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**FOREST FIRES IN NORTH CAROLINA  
DURING 1911**

By **J. S. HOLMES**

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**SUGGESTED FORESTRY LEGISLATION**



RALEIGH  
EDWARDS & BROUGHTON PRINTING CO.  
1912

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# GEOLOGICAL BOARD

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## LETTER OF TRANSMITTAL

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CHAPEL HILL, N. C., May 1, 1912.

*To His Excellency, HON. W. W. KITCHIN,*

*Governor of North Carolina.*

SIR:—A great gain has been made during the past year in forestry work in North Carolina by the organization of the North Carolina Forestry Association. As the North Carolina Geological and Economic Survey was instrumental in organizing this Association and as the Association is working in very close coöperation with the Survey, the proceedings of the Association are in part the record of forestry work of the Survey. For this reason I recommend that the proceedings of the annual convention of the North Carolina Forestry Association, which was held at Raleigh, February 21, 1912, be published as Economic Paper No. 25 of the publications of the North Carolina Geological and Economic Survey. I am including in this same Economic Paper a report on the Forest Fires in North Carolina During 1911, and also some Suggested Forestry Legislation for North Carolina.

Yours respectfully,

JOSEPH HYDE PRATT,

*State Geologist.*

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PROCEEDINGS OF THE SECOND ANNUAL CONVENTION

OF THE

North Carolina Forestry Association

HELD IN

Raleigh, N. C., Wednesday, February 21, 1912

PROCEEDINGS OF THE CONVENTION

MORNING SESSION.

The Convention was called to order in the Hall of the House of Representatives at 10:45 a. m., by the President, Dr. D. H. Hill. After the opening prayer, which was offered by the Reverend A. D. Wilcox, of the Central Methodist Church, President Hill introduced Governor W. W. Kitchin, who welcomed the delegates and visitors to Raleigh and to the Convention. The Governor's address was in part as follows:

ADDRESS OF WELCOME BY GOVERNOR W. W. KITCHIN.

While not congratulating you on the vast numbers present, I am glad to see so many here, representing such a varied citizenship. The accomplishment of your purpose does not depend on numbers, but on the enthusiasm and interest of those present and upon the literature which will go out from this meeting and this Association, and which will no doubt be read by thousands.

I am very much interested in the question of forest protection, but I realize that it is hard to get many people interested who have small forest holdings. This Association gives the opportunity to all citizens to join in the forestry movement. The net results will be beyond calculation.

If there is any land blessed by nature more than another, it is the Coastal Plain region of North Carolina. People wonder why longleaf pine will not reproduce itself on the cut-over forest lands of this region as the old field pine does. There is just one reason, and that is the hog. Hogs dig down in the loose, sandy soil and devour the succulent roots of the longleaf pine, whereas the roots of the shortleaf pine, being smaller and fibrous, escape destruction. In counties where hogs are kept from the forest you find young longleaf pines, showing that these pines under favorable conditions will reproduce themselves as well as the old field pine. I am not advocating a hog or stock law, as this is a local question for each community to solve. I am not in favor of killing all the hogs, either.

In the mountains of this State, where the forests are chiefly hardwoods, the underbrush and young growth, if allowed to grow up, will prevent floods and washing of the land as effectively as the old uncut forests.

This question of forestry must be brought home to the average man. Large holders are, of course, intensely interested; but the average man of North

Carolina has not the habit of saving; and the owners of the small forests ordinarily do not look far enough into the future to properly preserve their forests.

The forests of Germany and France and other European countries pay handsome incomes to the owners, whether state, municipal, or private, and the same conditions will prevail in this country. A Maine timberland owner told me a short time ago that he was cutting his timber under the direction of a trained forester, that he was cutting a large amount each year, but in spite of this the value of the land was steadily going up and the yield increasing.

I am in hearty sympathy with this work. We must not expect perfect laws all at once, but let us get a start and soon we will have an educated people who will adopt improved forestry methods. The earth was given not to one generation, but to all generations, and no man should think he has a right to destroy all the forests from the land in this generation, and then leave the next without timber, when by proper methods all generations can enjoy profits from the forests. A man has only temporary control of land; when he dies he leaves it to some other one. Because of this temporary ownership, because this land is being held in trust for generations to come, we have no right to destroy its future value and usefulness, whether it is farm land or forest land.

I gladly welcome you, and trust your deliberations will be productive of great good.

The President, Dr. D. H. Hill, made a short reply to the Governor's address of welcome and then delivered his annual address, in which he outlined the objects of the Association and strongly urged a campaign of publicity, both through the local papers of the State and by meetings gotten up by the various officials and members of the Association.

### WHAT CAN WE DO TO PREVENT FOREST WASTE?

BY D. H. HILL, PRESIDENT NORTH CAROLINA COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

Nations, like individuals and like corporations, have three ways of adding to their wealth:

First, by making more saleable products and making them at reduced cost and marketing them to better advantage.

Second, by utilizing hitherto waste products.

Third, by a wise management of the resources with which nature has endowed them.

In our country many forces are at work to increase the national output at lowered cost. Especially is this true of farm products. The agricultural colleges and experiment stations, the national and State departments of agriculture, the farm papers, and farmers' organizations, like the Farmers' Union and Soil Fertility Leagues, are bending every effort to make the soil reward man's industry by a richer return and to reduce both the money and the labor cost. Technical schools, too, are sending forth equipped engineers, industrial clubs are standardizing manufacturing plants, and in many cases



coöperation between owners and employees is lowering the cost of all kinds of wares. Marketing is also being more closely studied than before in our country, and coöperative marketing is succeeding in many localities.

All the batteries of science are being turned against waste in manufacture. The millions of dollars made each year in Germany since their skilled and enterprising chemists turned coal tar waste into dyes for the world is a signal example. The woodworks now find utilization for almost every scrap. Pine stumps are changing into turpentine bottles. Corn stalks serve multifarious purposes, and on every hand there is war waged against loss of by-products.

In the third case, namely, waste in natural products, the crusade is only fairly beginning. Taking men as the highest natural product, there is the war against the waste from preventable diseases like smallpox, consumption, hookworm, yellow fever, cholera, etc. This war, which is both humanitarian and economic, is enlisting more volunteers each year. Then veterinary science is striving for preventives against sick waste in the lower animals. The apparent success of cholera serum, the assured possibility of the eradication of cattle ticks, the tuberculin tests for cattle—these are evidences of practical activity in directions needed. The entomologists and the biologists are moving mightily to prevent sick waste in trees and crops. In mining natural products strides towards saving ores have been made. In the Kimberly diamond mines, for example, waste has been reduced to a negligible quantity. However, in the great question we are considering today, forestry, waste still looms prodigiously.

As all the speakers today want to be heard, not for much speaking, but for brief speaking, I want to present this thought: What can our Association do to prevent forestry waste?

First, we can try to change the American's attitude towards a tree. This is a hard task, but only hard tasks are entertaining. Of course we all recall the attitude of our early settlers toward the tree and remember the reason for that position. To them the trees were a twofold evil. They, in the first place, furnished a lurking place for their enemies—Indians and wild animals—and in the second place they kept the industrious ploughman from making a crop or even a road. Hence a tree, like an ugly woman or a peevish man, had few friends. The slogan of these settlers was, not "Swat the fly"; it was, "Swat the tree." Then as population increased, lumber of course became valuable and there was new reason for swatting the tree. Unfortunately, therefore, our attitude towards the tree became fixed and we are still swatting alike the giant oak and the pickaninny pine sapling.

We must needs try to unfix this attitude and create a new slogan, "Save the tree." Save it, first, for its economic value; save it, second, for its salutary influence in conserving rainfall, and preventing erosion; save it, third, for its perennial beauty. We can aid in teaching in our homes, in our schools, in our colleges that our forests are too imperial a resource to be ruthlessly squandered. We can help in raising up wardens to protect them and foresters to reproduce them.

Second, we can aid in the passage of a national law to prevent the importation of insect-infested and diseased plants. We have the unenviable status of being the only great nation that has no quarantine regulations against the importation of diseased plants. So careless are we in respect to diseased

plant stock that France, Germany, Switzerland, Holland, Austria-Hungary, and Turkey absolutely prohibit the entry into their borders of American nursery stock. If we may believe the United States Bureau of Entomology, "A properly enforced quarantine inspection law in the past would have excluded many, if not most, of the foreign insect enemies which are now levying an enormous annual tax on the products of the farms and orchards and forests of our country." According to Marlatt fully fifty per cent of the important injurious pests in this country are of foreign origin and have been imported into the United States through what it would be hardly too strong to condemn as indifferent stupidity. Among these pests are the codling moth, so destructive to our apple trees, the Hessian fly, the asparagus beetle, the hop plant louse, the cabbage worm, the wheat plant louse, the croton bug, the Angoumois grain moth, the horn fly of cattle, the boll weevil, the San José scale, the gypsy and brown tail moths that are destroying New England's forests, the Argentine ant in New Orleans, and the alfalfa leaf weevil in Utah.

Failure to prevent the importation of these pests costs almost untold sums in trying to control the diseases occasioned by them. It is estimated, again using the reports of the Bureau of Entomology, that the cost of spraying apple trees to prevent the codling moth is sixteen million dollars a year; the San José scale costs about ten millions a year in prevention alone. The New England States are now appropriating upwards of a million dollars a year to save their trees from the gypsy and brown tail moths.

In the third place, we can help by urging a State law to prevent the wasting of our forests by fire. It is certainly time that fire ceased to be the lazy man's lawn mower, the 'possum hunter's plaything, and the rabbit chaser's method of driving his game. We punish a man who destroys by fire our wealth in houses, barns, hay ricks or cattle, but we deem it a venial matter for a man to destroy our wealth in trees and plants. With absolute impunity a man may carelessly start and leave a fire that will rage for days and do damage almost beyond belief. If our Association could do no other thing than secure an acceptable law to prevent this destruction, it would certainly have justified its existence.

In the fourth place, let us remember that as a people, the newspaper is largely educating us; let us go to the papers. We can start a forest preservation publicity campaign by writing short articles for our local papers or by getting these papers to copy valuable articles from technical journals or bulletins. We must do this persistently and systematically. As soon as people thoroughly understand the waste now going on, understand how easily this could be remedied, understand how easily a forest can be reset to trees, understand what an increment in wealth such resetting would be, these things will all be done. The thing needed now is to get these facts into the minds of tenants, landowners, lumbermen, sawmill men, and all others who deal directly or indirectly with trees. Whenever a forest fire occurs in the neighborhood of one of our members, let that member get an accurate estimate of the loss caused by the fire and publish it in every paper in the county. If the figures are accurate, comment will be unnecessary.

These, then, are some of the things that our infant organization can attempt. If we give time and thought to these ends, we shall accomplish much.



The reading of the minutes of the last meeting was dispensed with, and the Secretary then read his annual report, which follows:

### SECRETARY'S REPORT

By J. S. HOLMES, FORESTER, NORTH CAROLINA GEOLOGICAL AND  
ECONOMIC SURVEY.

Since the organization of the North Carolina Forestry Association a year ago, much has been done by it to lay a foundation on which can be built a more general and intelligent appreciation of North Carolina's forest wealth and of the necessity for protecting it.

A large amount of correspondence has been carried on in the effort to secure a vice-president in every Senatorial District of the State. This finally resulted in the acceptance of this position by prominent men in thirty-four out of the thirty-nine districts. The other five districts have so far no representatives in our Association, but suitable men will be selected as soon as possible.

A meeting of the Executive Committee was called for September 21st last, the vice-presidents also being invited to attend. At this meeting a constitution, which will be submitted to this meeting for final adoption, was approved. The work of the Association for the winter was discussed, and two or three special lines of work were decided upon. Realizing the value of information in regard to the number of forest fires occurring in the State and the annual damage done by them, it was determined that this Association coöperate with the North Carolina Geological and Economic Survey in the collection of these figures in order if possible to increase their scope and reliability. In conformity with this decision, your Secretary sent out a request to all the vice-presidents, asking them to submit a list of men, one or more from each township in the several counties of their districts, who would be likely to answer questions about the damage done by forest fires during the past year.

Preparing such a list means considerable work, but nine of the vice-presidents submitted lists covering twenty-four counties. Questions were subsequently sent one man in each township on these lists, and the full returns from these counties seem to thoroughly justify this work. I hope that another year a similar list can be had from every district in the State.\*

As one of the objects of this Association is to promote the protection of the forests of the State from destructive insects, at the suggestion of the Association, two of its vice-presidents called meetings in their own districts last fall for the purpose of inaugurating a campaign to control the ravages of the Southern pine beetle, which have been so destructive to the second growth pine forests of the southern Piedmont counties. The vice-president of the Twenty-fifth District, Mr. W. S. Lee, called a meeting to be held in Charlotte on November 25th last. This resulted in the organization of the Mecklenburg Pine Beetle Association, which I understand has been doing splendid work during the present winter in the control of this insect. Mr. A. C. Stroup, vice-president of the Thirty-second District, called a meeting for December the 5th in Gastonia, and this meeting organized itself into the Gaston Forestry Association, the primary object of which was to stop the

\*The report on Forest Fires in North Carolina during 1911 is published as a second part of this Economic Paper.

ravages of the pine beetle in that county, but the association intends also to support other forestry measures which will be of benefit to the county. Whether these two associations are in direct affiliation with our State Association or not, we will take pride in coöperating with them in every way possible and will look upon them as our own children. I sincerely trust that the representatives from these two counties who may be with us, will give this meeting some idea of this work which is being carried on in them.

Of course, all this work could not have been carried on without the thorough support and coöperation of the North Carolina Geological and Economic Survey. The Survey looks upon this as the work for which it was organized and created by the Legislature, and so is very glad indeed to coöperate with the Forestry Association in every way that it can.

And here let me express the sincere thanks of the Secretary and of the Executive Committee to those vice-presidents who have coöperated so cheerfully and heartily in the duties that have been demanded of them. If the Association had a vice-president in every district who did as much as those who are taking a real interest in the work, the Association could make itself felt in a very short time in every corner of the State, and the object of this meeting, which is to arouse the people to the necessity of electing Representatives in our next General Assembly who will be interested in the matter of forest protection, could be attained.

I do not know whether or not it comes within the scope of a Secretary's report to call the attention of this meeting to certain pressing questions which the Association might take up in the near future, but, with the permission of the President, I am going to briefly outline a few ideas which I hope will be discussed at this meeting and some definite action taken. At the last meeting of the Association the principal topic of discussion was a proposed forestry law which had then been introduced before the General Assembly. This law was considerably changed by the committee appointed by this Association to draft a law, and was subsequently modified so that its passage at the last session of the Legislature might, if possible, be secured. Unfortunately, neither this bill nor any other general forestry bill was passed. The Association should bend every effort the coming year to impress upon the people and upon the candidates for the Legislature the pressing importance of passing some good forestry law during the next session of the Legislature. Our President has just outlined a plan of campaign looking to this end.

Forest Protective Associations furnish a plan for the protection of the forests from fire which can be operated by the owners themselves until the State assumes this duty. Such associations seem to me especially suited to certain areas of our mountain forests. Effective Forest Protective Associations have been organized in some of the Northwestern and Northern States, and Mr. W. B. Greeley, Assistant Forester of the United States, in an address to the Hardwood Manufacturers' Association, recently strongly recommended them as one of the best means of protecting mountain forests. In this connection Mr. Greeley says:

"Aside from action by the State governments, however, coats must be taken off and good gray matter expended in hard work on the protection of the individual timbered property. In this work, the experience of some of the Northern and Western timber owners as to the value of coöperation



should be of real value. One of the hardest problems confronted in protecting the individual tract of timber is the excessive cost per acre when this work is attempted on a small scale by each owner acting independently. In certain of the Northwestern States with which I am familiar, this phase of the question has been very effectively met by the consolidation of interests for the purposes of fire protection. This is done through the organization of timber protective associations which handle the work of fire patrol, construction of telephone lines and other necessary improvements, and the actual fighting of fire, jointly for all their members. Some of these associations, representing from 200,000 to 300,000 acres, headed by an executive committee and chief warden and meeting expenses by a pro rata assessment per acre, have developed the most efficient protection of timberland on a larger scale than any I have seen in any portion of the country, under any organization, public or private. Large areas of coniferous timber in the Northwest, where the character of the forest and the unfailing annual drought make the fire risk far greater than in the hardwood belt, are now being protected efficiently through such agencies at a cost in ordinary seasons of two or three cents an acre. It is my judgment that you will find the solution of your protection problem in this principle of coöperation with your neighbor and the pooling of common interests for this specific purpose."

I would like to call the attention of those who are personally interested in fire protection to the whole of Mr. Greeley's speech, which advocates fire protection as the most practical and most pressing need of timberland owners at the present time. It seems to me to point very clearly to the fact that even private or coöperative fire protection is profitable, and the matter is certainly worthy of careful consideration. If this Association could engineer the organization of such a protective association in western North Carolina, its existence would be amply justified though it did nothing else.

During the last session of the General Assembly, Governor Kitchin sent a special message to the Legislature, calling the attention of the representatives to the second section of the Weeks bill, just then passed by Congress and signed by the President. This section promised any State which should have a definite appropriation and a State system of fire protection, financial aid and assistance up to the amount of money appropriated by such State. It was the hope of the Governor that the North Carolina Legislature would pass such a law as would enable us to take advantage of this coöperative offer of the Federal Government. We have with us today Mr. J. G. Peters, of the United States Forest Service, who is in charge of the coöperative work of the Government under this bill, and he will explain this plan, which is now in operation in six or eight different States. After we have heard Mr. Peters, I think this Association should take some steps to endorse the work of the Government and try to get the State to take steps to secure its share of the appropriation and take advantage of this offer of assistance.

I have already outlined what has been done by the Association in the attempted control of the Southern pine beetle, but I want to add a word as to the future work along these lines. Reports from Cleveland and Union counties indicate that the pine beetle is as destructive in those counties as in Gaston and Mecklenburg, and I trust that local associations may be formed in these counties also for the organization of control work.

The question of forestry education in the colleges and schools of the State

is of very pressing importance, and I think the Association should endeavor to have this phase of education introduced and extended. I understand from our President that elementary forestry is being taught in the College of Agriculture and Mechanic Arts in Raleigh; with this exception, there is, so far as I am aware, no forestry education carried on in the State. The trustees of the State University have, I believe, decided to have some kind of instruction along these lines introduced into that institution as soon as sufficient funds may be provided by the Legislature. The women's clubs have had much influence in starting this phase of education, and I would respectfully suggest that they take up the matter of introducing forestry into the public schools and make it their chief forestry work for the ensuing year. I think the women of the State are probably more interested in the education of the children than they are in the passage of certain laws which the men are working for, and such a division of labor among the members and supporters of this Association might accomplish large results.

There is another way in which the women of the State can assist very materially in the movement to formulate a settled and permanent forest policy for North Carolina, and that is by securing the universal observance of Arbor Day. An Arbor Day was first advocated by the Honorable Sterling Morton over thirty years ago, and his own State of Nebraska was the first to adopt it. Since that time the observance of Arbor Day has become more or less general throughout the country; nevertheless, while Arbor Day exercises have been held sporadically in some of the schools of this State for a number of years, so far the efforts to make this a State custom have failed. Two or three years ago an Arbor Day Bulletin was prepared, to be published by the State Board of Education, but neither it nor the State Geological and Economic Survey, which prepared the bulletin, has received enough encouragement from the people of the State to justify them in publishing it. If all the school children of the State could take part once a year in some Arbor Day exercises, they might imbibe a certain knowledge of the value of our trees, both commercial and æsthetic, which would lead them to further study of the question and train them to look upon the forests as something to value and conserve, rather than to abuse and destroy, as, unfortunately, their fathers had been taught to regard them. I have no doubt that the women's clubs in the different towns could induce at least a local observance of Arbor Day, as they are doing this year in my own town, and, in so doing they would very soon pave the way for State observance of this day.

My final suggestion for work for the Association is concerned with a new and very pressing duty which devolves upon all North Carolinians who are in any way interested in the forests of the State, namely, the laying of thorough plans for immediate and vigorous attack upon the chestnut bark disease as soon as it invades this State. I had invited Dr. Haven Metcalf, the Chief Pathologist of the United States Bureau of Plant Industry, to attend this meeting and lay the matter before you. But, owing to a previous and more important engagement for all members of his staff engaged in this work, neither he nor any of his assistants were able to attend, so that I am going to take it upon myself to outline in a short paper the nature of this menace and suggest action that may be taken by this Association to provide against it. Suffice it to say here that when the time comes, prompt and effective action must be taken, and this Association should lay its plans so that it will know exactly what to do and how to do it.



And now, to recapitulate briefly: What are the forestry questions most prominent at this time which the Association can assist in solving?

(1) The question of fire protection is uppermost in the minds of most of us, and we should make a special effort the coming summer to bring this to the attention of the voters, and especially to the attention of the prospective candidates for the Legislature, with the hope of getting an Assembly favorable to forestry legislation.

(2) This must be done, and some kind of legislation passed before the second question can be taken up, which is, the coöperation of the State with the Federal Government in fire protection on the headwaters of streams, as will be explained by Mr. Peters.

(3) Wherever the pine is being destroyed by the pine beetle, the Association should make a special effort to found local associations in the counties affected, and then coöperate with them in every way possible.

(4) The Association should encourage and advocate the teaching of forestry in the colleges and public schools of the State, and should endeavor to make the observance of Arbor Day universal.

(5) The Association should take up in earnest the question of the chestnut bark disease, and bend every effort to keep it out of the State and then, should it get into the State, to combat its spread.

Finally, all these measures could be pushed forward most successfully if we had the coöperation of the State Legislature, so that small State appropriations might be made for the purposes of controlling forest fires, of coöperating with the United States in fire prevention, of coöperating with counties in the fight against the pine bark beetle, and of coöperating with the United States in the protection of our forests from the chestnut blight disease.

Motion was made and passed that the Secretary's report stand approved.

Mr. Holmes then read a paper on "The Chestnut Bark Disease."

### THE CHESTNUT BARK DISEASE WHICH THREATENS NORTH CAROLINA.

BY J. S. HOLMES, FORESTER, NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

Just four years ago Mr. Haven Metcalf, of the United States Bureau of Plant Industry, in a brief circular\* wrote, "The bark disease of the chestnut caused by the fungus *Diaporthe parasitica* (Murrill), has spread rapidly from Long Island, where it was first observed, and is now reported from Connecticut, Massachusetts, Vermont, New York as far north as Poughkeepsie, New Jersey, Pennsylvania, and possibly Delaware. It is no exaggeration to say that it is at present the most threatening forest tree disease in America. Unless something now unforeseen occurs to check its spread, the complete destruction of the chestnut orchards and forests of the country, or at least of the Atlantic States, is only a question of a few years' time."

Since that time two or three circulars have been issued on the subject by the United States Bureau of Plant Industry as well as numerous articles and

\*"The Immunity of the Japanese Chestnut to the Bark Disease," by Haven Metcalf, Bul. 121, Pt. VI., Bureau of Plant Industry.

bulletins by the different States. This disease has now spread into Virginia and West Virginia, and seriously threatens the forests of this State. Mr. Metcalf writes, in answer to my letter asking him to be present at this meeting:

"I regret very much that it is impossible for me to come myself, or send you a man for the meeting of your Association, as it seems necessary to have every one at Harrisburg who has any knowledge of the disease. I regret very much being unable to be present myself, as there is a good deal to be said on the subject of the chestnut bark disease, and I have little doubt that it will reach North Carolina by another year."

The meeting at Harrisburg to which Mr. Metcalf refers, has been called by the Governor of Pennsylvania to consider ways and means for combating this disease, which has now spread over the larger part of that State. Invitations were sent out to interested people all over the Atlantic States, and three of the men whom I had hoped to have at this meeting have had to decline on account of attending the meeting at Harrisburg yesterday and today.

At a recent meeting of the foresters from the Eastern States in New York, at which the writer and many prominent railroad men were present, the whole time of the meeting was taken up with a discussion of ways and means to dispose of the enormous amount of dead chestnut in the southern New England and North Atlantic States which has been killed by this disease.

Not only were reduced rates on the railroads advocated for dead chestnut wood, so that immediate cutting of the infected timber could proceed without serious loss, but the erection of new plants for the utilization of this dead chestnut wood through the most seriously affected regions of New England, New York, and Pennsylvania was strongly urged.

Last year the State of Pennsylvania appropriated \$275,000 "for the investigation and scientific study of this problem, and, more specifically, to ascertain the exact extent of the blight, and to devise ways and means through which it might, if possible, be stamped out."

The Pennsylvania Chestnut Blight Commission, which has been appointed to carry out these provisions, is carefully studying the disease and at the same time taking strenuous measures to prevent its further spread. They are asking neighboring States who are threatened with this pest to coöperate with them in every way possible.

The chestnut timber of North Carolina means more to the farmers, the timberland owners, and the manufacturers of the western part of the State than any other tree. According to an estimate made by the North Carolina Geological and Economic Survey in coöperation with the United States Forest Service, there are slightly over three million acres of forest land in North Carolina now growing a larger or smaller proportion of chestnut timber. On this area, mixed with many other species, there was a stand in 1909-'10 of approximately 3,380 million feet board measure of chestnut timber. In addition to this there was at least one and one-half million cords of chestnut cordwood that could not be converted into lumber. Putting the low stumpage value of one dollar per thousand or fifty cents per cord on this timber, we have a present value for the chestnut timber in North Carolina of at least four million dollars.

The cutting, marketing and manufacturing of this timber will mean at least forty million dollars to the citizens of this State, and there can be no



doubt but that an annual income of at least one million dollars could be permanently secured from the chestnut timber alone, were these mountain forests managed in a conservative way. Chestnut is the tree best adapted to all situations in our mountains, and is the tree that comes soonest to financial maturity, while its use for lumber, for telephone poles, for tanning extract, and for pulp, makes it the most widely useful tree commercially of any in that region.

Can we afford to lose this important source of revenue without a struggle? We certainly can not.

Every member of this Association can do something towards delaying or preventing the invasion of this State by the chestnut bark disease by writing to his Congressman to support the bill now before Congress, which calls for an appropriation of \$80,000 for the use of the United States Department of Agriculture, to be used in a thorough study and investigation of this tree disease, with the view of devising ways and means to combat its further spread. If this bill is passed, the department would undoubtedly send experts into North Carolina the coming summer to watch out for this disease and to plan a campaign to prevent its invasion or its further spread, should it appear in this State. I think also that this Association, as a body, should go on record as approving this bill.

Every person who goes into the woods where chestnut grows, should make a point of looking out for this disease and reporting it to the Government as soon as it is discovered, that immediate steps may be taken to combat it.

In order that I need not take up valuable time with a description of the appearance of this disease, I have brought a sterilized sample, which was sent me by the Bureau of Plant Industry, which all who are interested can examine. Anyone who has once seen it will have no difficulty in recognizing this disease.

For detailed description and suggested methods of control, I would refer you to Farmers Bulletin 467, issued by the United States Department of Agriculture, and to the report on the Harrisburg Chestnut Bark Disease Conference which will no doubt be published without delay by the Chestnut Blight Commission of Pennsylvania.

Mr. E. B. Mason, an expert in the office of Forest Insect Investigations of the United States Bureau of Entomology, who the past year was in charge of the Spartanburg (S. C.) Field Station of that office, which was charged with conducting a campaign for the control of the Southern Pine Beetle through the South Atlantic States, was then introduced. Mr. Mason's address was as follows:

### THE SOUTHERN PINE BEETLE AND ITS CONTROL.

By E. B. MASON, UNITED STATES BUREAU OF ENTOMOLOGY.

GENTLEMEN:—It is a great pleasure for me to be present at this meeting for three excellent reasons:

First, because the first State recognition of our efforts to show the people of the South how to save their pine from the attacks of the Southern pine beetle was from North Carolina.

Second, because to the coöperation of the North Carolina Forestry Association, with those interested, was due the formation of the Mecklenburg Pine Beetle Association and the Gaston Forestry Association, which were followed by the formation of similar organizations in other Southern States.

Third, because these two associations formed for fighting the beetle are not merely names, but have actually performed the work for which they were organized.

I look forward with confidence to a time within the near future when we can say that the people of North Carolina have established systematic insect control for the benefit of every pine timber owner in the State.

I do not think it necessary for me to dwell on the seriousness of the situation in regard to the Southern pine beetle. There is not a man here who has not seen the appalling amount of dead pine. This dead pine is gone. We can not bring it to life again, but we can, and I am sure we will, try to stop the dying of further large quantities of timber. Since it is possible for us to make efforts in this direction, it seems to me that we should look on further loss from this cause as absolutely unnecessary, and hold no one but ourselves to blame for it.

The Southern pine beetle has existed, to our knowledge, in the South for over forty years. It is only at long intervals, however, that it increases to such numbers as to cause widespread depredations such as the great invasion of 1890-'93, which destroyed a large percentage of the pine in the Virginias and was only stopped by unusual climatic conditions. The warning sign of a depredation is the increase in number and size of the groups of dying pine. This warning has been only too plainly manifest the last two years. We have no reason to anticipate that any natural factor will come to our aid. We should be more than foolish if we based our hopes of relief on any such intervention of Providence. In other words, gentlemen, it is distinctly and plainly up to us.

In order that you may understand the reasons for the methods of control we advise, I am going to run through the life history of this beetle, beginning with the early summer, as outlined by Dr. A. D. Hopkins, who is the authority on forest insects of the Department of Agriculture, Bureau of Entomology.

The beetles attack and leave a tree in about thirty days or even more quickly. Three or four generations in the North and four or five in the South develop during the season. In other words, they may be increased thousands of times from their original numbers during the year. They fly during the night, and sometimes in the day, and alight on the upper trunk of a living pine. (Observation has shown that they seldom go as far down as the first eight or ten feet of the butt cut, depending, of course, on the size of the tree.) When they alight on a tree they bore through the bark to the wood, but they do not bore into the wood. In the inner bark and marked on the surface of the wood they make those winding galleries with which you are all familiar. These galleries, crossing and recrossing, girdle the tree many times, thus killing it. The eggs are laid along these galleries, hatch into little grubs, which feed for a short time on the inner bark, and then go into the outer bark where they change into beetles with wings. The beetles bore out of the bark to the light, fly away and attack other trees. They can fly for three or four miles or more, may go in any direction, and, therefore, are a direct menace to all pine within three or four miles of a center of infestation.



Since they kill and leave a tree in thirty days or even more quickly, you will never find their broods in old dead trees or trees from which the foliage has fallen. You will find many other kinds of beetles in old dead trees, but never this one. You will find this beetle in trees on which the foliage has begun to fade to light green or has faded to yellow or greenish brown. In fact, after November 1st, any dying or dead trees which retain their foliage are apt to harbor the hibernating beetles, and in addition they are also found in trees on which the foliage is green but which have pitch tubes on the trunk—these trees fade later.

After November the beetles remain in the trees and instead of coming out in thirty days they don't come out till spring. You have them trapped. That is the time to go after them. It is only necessary to cut down the trees containing the beetles and destroy the bark in which the broods are spending the winter. You do not have to destroy the wood, you do not even have to destroy the tops and laps. Bear in mind that the beetles have left the old dead trees from which the foliage has fallen. The old dead trees may be totally disregarded in control operations.

About destroying the bark in which the broods of the beetle are wintering, it can be destroyed in several ways and in most cases in such a manner as not to involve a direct expense. The tree in which the beetles are spending the winter may be turned into cordwood. This cordwood should be burned, however, and care should be taken to gather up the bark that falls in cutting between November 1st and May 1st. These same kinds of trees may be turned into timber, but the slabs with the bark on must be burned between November 1st and May 1st. There are other methods, but these are the principal ones. In all methods the underlying principle is the same—the destruction of the bark in which the broods of the beetle are wintering.

You notice I have confined control operations to the winter. There is an excellent reason for this. The cutting of any dead or living pine during the summer months in a beetle infested country will attract the beetles from three or four miles. They will go to some extent into the fresh felled green timber, but the greater part of the attack will be against the surrounding healthy timber. It is therefore a very dangerous thing to cut pine during the summer unless every one in the neighborhood cuts their dying infested trees at the same time and destroys the bark. Of course, when the beetle is under control there should be no reason for not cutting timber at any season of the year.

I want to speak briefly on two popular errors. Some people will tell you that the dying of the pine during the last summer was due to the drought. Trees have been dying every month in the year in moist as well as dry localities, in wet weather as well as in dry weather. Drought is, therefore, out of the question. Many people will tell you that the death of the pine is due to the sawyer or borer. This is a natural mistake, because of the size of the sawyer and the noise which it makes when at work. It is, nevertheless, a mistake. It has long since been determined that this class of borer never attacks a living, uninjured pine. It comes in while the beetle is working or after the beetle has left the tree.

We can divide the problems to be met into two divisions: The woodlot proposition and the lumbering proposition. In the woodlot proposition the owner uses his woodlot for his fuel supply. He can just as well use his in-

fested trees for cordwood and thus control the beetle at no expense. On large holdings where cutting is going on the desired result can be obtained by burning the slabs from the infected trees with the bark on. Where the timber is to be held and there is no market for cordwood, control measures must be conducted at direct expense. The question to determine is whether the amount expended will be justified by the timber saved. Disregarding the increase in the danger of fire from the dead timber and the very great possibility of an increase in the number of trees killed each year, I want to say distinctly to you that it *will* pay. The trouble with the large holders is that they do not know how much timber they are losing.

No lumberman who is suffering from inroads by the beetle, after he has made an investigation into how much timber he is losing, will hesitate for a moment in starting control operations. He will not hesitate any more than he would hesitate to go out and fight a forest fire—indeed, an attack by insects differs only from a forest fire in that you have more time to fight it, and I quote your forester, Mr. Holmes, as saying that more timber has been killed in the southern Piedmont section of North Carolina by the Southern pine beetle than has been killed by fire.

Gentlemen, the proposition is up to every individual timber owner. Dr. Howard, Chief of the Bureau of Entomology, has put the resources of the Bureau at your service. We can only give advice, however. You must do the actual work. If all will help, if all will go at the very simple task before them without waiting for their neighbors to begin, we can control this beetle and save an amount of pine from dying, the value of which I should not dare estimate in dollars.

Gentlemen of the North Carolina Forestry Association, I have endeavored to put this matter before you as simply as possible. If there are any questions unanswered in your minds, do not, in justice to yourselves and to us, let me go away with them unanswered. I think you will agree with me that every man here who controls pine timber should get at this matter at once. It does not admit of delay. Realize that you are engaged in a labor not only for yourself, but for your neighbor, and indeed for the whole South, and let your watchword be, "Do It Now."

A general discussion followed Mr. Mason's speech, in which Mr. Z. W. Whitehead, of Wilmington; Dr. C. H. Herty, of Chapel Hill; Mr. W. S. Pharr, of Charlotte; Mr. G. K. Massengill, of Four Oaks, and several other delegates, took part.

Honorable James R. Young, State Insurance Commissioner, then read a paper on what his department can do to prevent forest fires. This address was as follows:

### ENFORCING THE PRESENT FOREST FIRE LAWS.

BY JAMES R. YOUNG, INSURANCE COMMISSIONER.

It is especially gratifying to me to be present at your meeting and by my presence and words endorse and extend aid to the North Carolina Forestry Association in the great work it is undertaking to do in the preservation of our forests. Upon me as a State official devolves the duty of attempting their



preservation by enforcing the law upon our statute books to punish any one responsible for their destruction or injury by fire, and I most heartily welcome the aid of the members of your Association, both collectively and individually. We are justly proud of our great nation; but as a people we are at the same time the most progressive as well as the most careless and wasteful people on earth. There are none equal to us. It is, indeed, a hopeful sign that we are being aroused by the cry of "Conservation." It is encouraging to see many of our best men traveling over this broad land, stirring up and organizing our people to aid in the conservation of America's natural resources. That much has been and more will be accomplished goes without saying, for who is not in one way or another endorsing this great work and aiding in its accomplishment!

#### FIRE WASTE.

I venture the assertion, and feel that I can make good the statement, that in no field is there a greater need of conservation, or an opportunity of so certainly accomplishing big results as in stopping our fire waste. We can and should hasten the day when we as a nation no longer countenance in our midst the criminals who, by carelessness, indifference, or deliberate incendiarism, are destroying our property and menacing the lives of our men, women, and children. The total fire losses in the United States and Canada during the year 1911 were \$234,337,250, and during the past thirty-five years these losses amount to \$5,181,345,425. These figures do not include the cost of insurance nor the money expended in fire departments.

The fire losses and cost of fire prevention in the United States amount annually to \$450,000,000, or more than the total American production of gold, silver, copper, and petroleum in a year.

Fire losses exceed the total cost of the army and navy of the United States for a year, and are greater than the annual expenditure for pensions, or the annual cost of the United States Postal Service. Fire in the United States costs over five hundred dollars each minute. Every two minutes the value of the average home of our working man goes up in smoke; while every ten or fifteen minutes there is consumed by the flames the value of fine homes such as we point to with pride as ornaments to our cities and towns. As if this were not enough to arouse us, over fifteen hundred people are killed and more than five thousand injured annually by the result of fires.

#### PREVENTABLE.

This great fire waste is preventable to a large extent, and by the exercise of even ordinary care and foresight over one-half of our fire waste can be prevented. The general per capita fire waste in the United States is \$2.51; in Europe, 33 cents. Cause: The latter has better construction, less carelessness, and increased responsibility. In nothing is the old adage, "An ounce of prevention is worth a pound of cure," so true as in stopping our appalling annual loss by fire. If the buildings in the United States were fireproof, as in Europe, the annual cost of fire losses and protection would be less than \$100,000,000.

The enormity of our fire waste and its effects upon the business and progress of our country is shown by the importance of the business of fire insurance.

The insurance companies engaged in this class of business alone have assets of about \$450,000,000. In 1910, one hundred and seventy-five stock fire companies assumed risks of \$36,357,713,046 for premiums of \$273,557,380, while in North Carolina alone \$257,375,954 were assumed in risks for premiums of \$3,296,096. The fire losses in North Carolina amount annually to practically \$1,500,000, or \$4,000 a day, and yet with proper care two-thirds could be prevented, with a saving to our State in taxable property and to our citizens of \$1,000,000 a year, or over \$2,500 a day. The loss of property is not all, for, as in the rest of the country, there is a great loss of life. During last year I noted in the papers twenty-one persons who lost their lives by fire in this State; while so far this year, with only one and a half months gone, the State papers have recorded already as burned fifteen persons, of whom twelve have died as the result so far.

#### FOREST FIRES.

In 1910 the loss by forest fires was \$26,000,000, or over ten per cent of the fire waste of the country. If the same per cent holds good in our State, and I see no good reason why it should not, then the annual loss in North Carolina by forest fires amounts to \$150,000. This can hardly be considered a large estimate when you count not only the standing timber and buildings but the destruction of buildings and small growth.

My observation would lead me to believe that by far the larger bulk of this loss was caused by thoughtlessness and carelessness, rather than by maliciousness. This shows the wisdom of our legislators in providing for the punishment of those responsible for fires due to either cause, as set out in Section 3346 of The Revisal of 1905 of North Carolina, as follows:

SECTION 3346. *Woods*.—If any person shall set fire to any woods, except it be his own property or, in that case, without first giving notice in writing to all persons owning lands adjoining to the woodlands intended to be fired, at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands near to or adjoining the lands so fired, he shall, for every such offense, forfeit and pay to any person who shall sue for the same, fifty dollars, and be liable to any one injured in an action, and shall moreover be guilty of a misdemeanor.

Of course, I have had some forest fires investigated, but so far I have not had the success in ferreting them out and punishing the originators as I have in other fires, where I have obtained five convictions since January 1, 1912, and one hundred and thirty-three since I have been charged with this fire marshal work in this State.

All laws designed to stop fire waste are largely educational, and accomplish much when handled in this way; hence, I have attempted to spread this law over North Carolina in the form of posters, such as you see distributed among you today. These posters are sent out to the sheriff and other officers of our counties, as well as to all lumber companies and others interested in the protection of our forests. The Department will continue to send them in such quantities to any citizen of North Carolina as they will post or distribute.

Of course our attempts to stop forest fires must take into consideration all the different causes for which they are started, and our people must be edu-



cated to realize that the results along the lines desired do not by any means compensate for the possible, or even actual loss by such fires. There are many things that in themselves appear to be small that cause these forest fires. The night hunter, by carelessly handling his torches, or leaving fires in the woods to be fanned into flames and spread by rising winds, often starts a fire that sweeps over the forest and does immense damage. Again, the smoker in passing through the forest, or the hunter by day or night, carelessly throwing aside the stump of a cigar or cigarette, or shaking the ashes from a pipe, starts a fire that spreads over the whole country and does immense damage. A great many of our owners of lands have undertaken to prohibit hunters from passing through their lands, and in this way a considerable prejudice has been raised against landowners, the hunters feeling that the objection is raised purely because of the game that they seek, while as a matter of fact the landowner is more interested in preventing damage to his lands by fires than he is in the game caught upon his land or a few trees cut down by the night hunter. A proper education must be undertaken and carried out to overcome this prejudice.

Again, the farmer in clearing his lands in the spring will build up fires to burn off the brush, and by carelessness or thoughtlessness allow the flames to be carried into adjacent fields or forests by the winds prevalent in the spring, and thus the country around for miles will be swept by fire and a damage done that will amount to more than all the crops that will be raised on the lands being cleared. The farmers need to be educated to the danger of spreading these fires, and the necessity of laws for the prevention of these fires in order to do away with the damage caused by them. Again, the railroads should be required by law to keep their rights of way so protected from the surrounding country that the sparks from their engines will not start these fires, for they not only do a great damage to the country and the owners of the lands, but tend to promote a prejudice between the people and the railroads.

In conclusion, Mr. President and gentlemen, I beg to say that it will afford me great pleasure to do anything I can in enforcing the laws that we now have on our statute books to prevent forest fires, and to aid in having our Legislature to add other suitable and necessary laws, and especially should these laws be so formed and enforced that the people may be educated to realize their advantage and necessity, so as to lessen instead of increasing the friction between the different classes of our people. We have already had some of this in the prejudices brought against lumber companies who have undertaken to protect their holdings by prosecutions against parties for starting fires.

I will unite with you, and use every means in my power in enforcing the laws, and reducing our fire waste from this cause in our State.

An interesting discussion followed Mr. Young's paper, in which Mr. Joseph Hyde Pratt, Mr. J. S. Holmes, and others took part.

Mr. Joseph Hyde Pratt, State Geologist, then gave a talk on the work the North Carolina Geological and Economic Survey was doing to

interest the people in the subject of forest protection. His address was as follows:

### FORESTRY WORK OF THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

BY JOSEPH HYDE PRATT, STATE GEOLOGIST.

The North Carolina General Assembly of 1905 reorganized the North Carolina Geological Survey, changing its name to the North Carolina Geological and Economic Survey, and in stating the object of the Survey the law says, in part, that the Survey shall make examination of the forest resources of the State and shall make a classification of the forests with special reference to their bearing upon the occupation of the people; and shall study a plan for protection of the forests, with special reference to the preservation of the flow of streams and water powers of the State. This phase of the work of the Geological Survey has become one of its more important problems and studies.

It has been estimated that approximately eleven million acres of land in North Carolina are now supporting some kind of forest growth. Nearly one-half of this area is probably absolute forest land, that is, the land is too rough to cultivate properly; is too easily washed by rain or floods; is too poor to yield adequate returns for the labor put upon it, or, for other reasons, the production of timber crops is the most profitable use to which it can be put, for a great many years to come. This large amount of forest land represents an investment of from twenty-five to fifty million dollars at the least. One-sixth of the entire wealth producing capital of the State is invested in forest lands or in industries directly depending upon the products obtained from the forests. Thus it is seen that the problems relating to forestry are most vital to the industrial life of the State, and the State should put forth every effort to make these forests as nearly perpetual as she possibly can, and encourage and stimulate the owners of these lands to assist her in conserving them.

The Geological and Economic Survey has from its investigations realized most thoroughly the need of conserving and protecting the forest areas of the State, and has for the past two years employed constantly a forester to investigate and assist in carrying out measures that would tend toward awakening the people of North Carolina to a realization that some legislation must be enacted to prevent the total destruction of our forests, and thus one of the most valuable assets of the State.

The forestry work is varied in character and consists of:

1. An investigation of the forest conditions of North Carolina.
2. A study of forest fires in North Carolina.
3. A statistical study of the wood-using industries of North Carolina.
4. The examination of timber areas in regard to practicing scientific forestry.
5. Examination of watersheds belonging to municipalities in regard to their protection from fire and contamination.
6. Investigations regarding the reforestation of abandoned farm lands and cut-over lands.

In order to obtain more accurate knowledge regarding the timber resources of the State, it was decided to make a thorough investigation of the various conditions of the forests, county by county, so that the Geological and Eco-



conomic Survey would be in a position to answer the many questions that were being asked regarding our forestry resources, such as:

What are our forest resources, and how long are they likely to last at the present rate of timber consumption?

Can we insure a permanent supply for our manufacturers, as well as for domestic and other uses?

Is the timberland yielding to its owners and to the State as large returns on the enormous amount of money invested as is possible?

Can the actual yield be increased?

Over fifty counties have thus far been examined and one report has already been published on the timber resources of the counties west of the Blue Ridge. The counties in the western half of the Piedmont section have also been examined and a report has been prepared on this which will be published at an early date.

By far the greatest enemy which the forests of the State have to contend with is fire. The destruction wrought by the annual and periodic fires which burn over many thousand acres of woodland each year involves an enormous loss to the people of the State through the diminished value of their property. No attempt has ever been made to collect statistics regarding the amount of damage to our forests from this source, but it was considered advisable by the Survey to obtain such data so that it could show more forcibly to the people of the State what they were losing each year from the effects of forest fires. Unfortunately, forest fires usually have been taken as a matter of course by our people, and in many cases have scarcely been noticed. Our lumbermen, however, have begun to realize that with the possible exception of land supporting mature pine timber with little or no young growth, ground fires can do and are doing great injury to our timberlands. Our farmers and other landowners are beginning to realize that every time a ground cover of leaves is burned up the land becomes that much poorer. Owners of waterpowers know that with the burning of the woods the rains run off faster, permitting a much smaller amount of water to soak into the soil, so that floods and periods of low water are both more frequent. Cattle-men who have contended that by burning the range they get earlier grass for their stock are now beginning to realize that in doing this they are really killing the goose that lays the golden egg, for by burning they get less and less grass every year. The man who owns forest land and is holding it for increase of growth, both for domestic supply and for sale, has learned that he is losing at least half the yield he ought to get by allowing his woodland to be burned over. Unfortunately, however, it is necessary to instruct the people at large regarding the great loss to the State by forest fires before we can obtain legislation that will give the necessary protection.

A series of studies has been made regarding the forest fires of North Carolina and statistics have been collected for several years regarding the number of fires, their causes, damage done, etc. The results of these investigations have been published as Economic Papers Nos. 19 and 22. The damage done by fires is estimated as over \$400,000 per year during the past three years.

Although there are a number of laws on the statute books of North Carolina relating to forest fires, yet the machinery necessary to carry out these laws has never been passed, and it is absolutely necessary that other laws shall be passed if we are to preserve our forests from fire.

As such a large part of North Carolina's wealth is invested in timberland and wood-using industries, and realizing the growing shortage in the supply of timber suitable for the use of these wood-using industries and the consequent gradual modification in the requirements fixed by these consumers, and recognizing the value both to the producers and consumers of timber of a more intimate knowledge of local market conditions, the State Survey has made a statistical study of the wood-using industries of the State.

This report has been published as Economic Paper No. 20, on Wood-using Industries of North Carolina, and should be of value to the State in assisting her in forming an independent forest policy, and in presenting the advantages the State offers to wood-using industries to locate in it. The timber owner—even the farmer who has a few scattered trees to sell—can learn from this report where a market can be found. The sawmill operator may learn a new use for a wood which he previously considered of little commercial value. The manufacturer will have a source of fairly accurate information concerning a region most likely to supply the lumber he needs. The merchants throughout the country who handle wood products can obtain considerable advantage in buying and selling. There is given in the report the uses of the different kinds of wood that grow in North Carolina and as complete a list as possible of manufacturers who use wood.

Other lines of forestry work taken up by the Survey are the examination of private forest lands for the purpose of recommending improved methods of management and the examination of watersheds from which cities or towns obtain their water supply, in order to recommend the best method of protecting these watersheds from fires and contamination.

The reforestation of cut-over and abandoned farm land is another phase of forestry work that demands considerable attention of the forestry division.

Many hundred thousand acres in all parts of North Carolina now lying either entirely waste or producing scarcely any timber of value can be made to yield their full capacity and make remunerative returns to their owners. The forest lands that have been cut over once or twice can be made to produce other cuttings as valuable as any that have already been removed. In order to secure reproduction it is necessary that seed trees should be left on the cut-over lands to furnish the seed required, or else it will be necessary to set out young trees or sow seed brought in from outside. Then there must be adequate protection for the young growth, and fire and stock must be kept out of the area. Besides these cut-over areas there are many thousands of acres, especially in the middle and western portions of North Carolina, which have been cleared for cultivation and proved unprofitable. Whatever may have been the cause of this, the lands should be reforested. Where lands of this character do not naturally restock in trees, they can profitably be planted in some desirable species. This will not only insure some earning from such land, but it will protect it from washing or deterioration.

/ Young trees are very susceptible to fire, and many of them, such as the pines, are destroyed in large quantities by stock and hogs, when these are allowed to run at large. Thus, if good results are to be obtained in reforestation, it is absolutely necessary that the planted areas be protected from fire and stock. This is just as true when applied to forests that are reproducing themselves, because the young trees must have a chance to grow, for unless



there is young growth and abundance of it there can be no trees to take the place of the old ones when they are cut.

The chief injury to our forests from cattle, however, is an indirect one, not only in the mountains, but wherever the stock law is not in force. Every year fires are set out and thousands of acres are burnt over in practically every county in which the cattle still run at large, the reason given being that "it improves the range." There is no more widespread or fallacious argument advanced as an excuse for burning the woods than this. And the only basis for it is that the young herbage, having no old growth to cover it, is available for the stock somewhat earlier in the spring if the ground is burnt over in the winter. The total effect of burning the range is very harmful, not only to the woods, but to the range itself. The soils get poorer and poorer year by year by the destruction of all vegetable matter, while the better quality of forage plants are seriously injured or killed out by the fire. The quantity of the poorer kinds of grass which make only early spring pasture, may be slightly increased by killing out the young trees and bushes, but the other forage plants, such as the beggar lice and other peas, on which the stock fatten in the fall, are seriously injured or killed out entirely by fire.

The sooner the whole State comes under the operation of the stock law, the better it will be, not only for the State at large, but more especially for those parts that are now without its advantages. The chief thing lacking to make many parts of North Carolina prosperous agricultural regions is the enforcement of a stock law. Only by putting all the land to its highest use, namely, by cultivating thoroughly and raising as much stock and feed as possible on the cleared land, and by keeping the woodland in the best possible condition by excluding fire and stock, can the present and future prosperity of a community or a State be assured. If it is impossible to bring the whole State under a stock law, there should be a law passed which would make it obligatory on those counties which do not wish a stock law to fence themselves from the counties that adopt the stock law. Thus the counties which wish the open range would be compelled to build a fence entirely around the county, and also be compelled to keep up these fences.

The forestry work that the State Geological and Economic Survey is doing can be very much increased and assisted by the North Carolina Forestry Association, and as State Geologist I can assure this Association of the most hearty coöperation of the Survey in the great work that this Association is undertaking.

Attorney-General T. W. Bickett, who was on the program for an address on the "Forest Fire Laws of North Carolina," explained that owing to insufficient notice having been given him he had been unable to prepare a paper. He, however, showed his interest in the question by attending, and offered his services to the Association in drafting any necessary laws which the Association might recommend. The President then appointed the following committees:

*Committee on Resolutions.*—Mr. E. B. Wright, Mr. C. P. Heyward, Professor J. F. Webb, Dr. F. P. Venable, Mr. Hugh MacRae.

*Committee on Nominations.*—Mr. Alston Grimes, Miss Annie F. Petty, Dr. C. H. Herty, Mr. W. S. Pharr, Mr. C. C. Smoot, III.

*Auditing Committee.*—Mr. D. A. White, Mr. R. R. Cotten, Mr. Z. W. Whitehead.

The Convention then adjourned to meet at three o'clock.

#### AFTERNOON SESSION.

The afternoon session was called to order by President Hill at 3:10 o'clock, in the Hall of the House of Representatives. Mr. Alston Grimes, of Pitt County, a vice-president of the Association, was introduced and gave an interesting talk on the profits in forest management in Pitt County, and the efforts being made to keep out fires.

He told first of a neighbor of his who bought a tract of land for \$500 from which he had sold \$3,500 worth of timber, retaining still the land and much of the timber. The neighbor, he said, had preserved the forests by prohibiting hunting. "I have not been successful myself in this respect," Mr. Grimes said, "but after giving written permission I do not allow the hunter to carry an axe and chop the 'possum tree down."

Mr. Grimes said he required all of his tenants to pay five dollars an acre when fire is allowed to run over land for which they are responsible. "They think it is a hardship at first, but agree afterwards that it is the right thing."

Mr. C. C. Smoot, III, of Wilkes County, another vice-president, then gave a short account of the Wilkes way of fighting fires where a neighborhood war was waged against the blazes of the community. He said he had become greatly interested in the fight against the blight which is killing the chestnut trees in the States to the north of us and which threatens to invade our own State.

Mrs. Al Fairbrother, a delegate from the Woman's Club of Greensboro, was then called upon by the President to say a word upon the subject from the viewpoint of the ladies. She said she had not come as a speaker or as a suggester, but as a learner. She said that the Woman's Club in Greensboro was going upon the principle that one of the chief civic works was to educate the children in conservation. She told of some of the work done by the ladies of Greensboro, such as the recent establishment of a children's playground there, which is the first public playground in North Carolina. This was accomplished entirely through the work of the Civic Association.

The President then called on Mr. W. D. Johnson, a colored man who is Agent of the United States Forest Service now temporarily stationed



at the colored Agricultural and Mechanical College at Greensboro, to say a few words about the interest of our colored citizens in forest protection.

Mr. Johnson declared that as poor a man as he is, he would have declined a gift of \$500 rather than have been kept from this meeting. He was born in the old country, he said, and had not known what the dominant race has done for the colored people until he came to the South. "I want to say," he said, "that not half what has been written and said about this question is true." He declared that as an agricultural race, a knowledge of forestry would be a great help to them.

Mr. J. G. Peters, Chief of State Coöperation in the United States Forest Service, who had come down from Washington especially for the meeting, then made an address on "State Coöperation in Fire Protection With the United States, Under the Weeks Law."

### COOPERATIVE FIRE PROTECTION UNDER THE WEEKS LAW.

BY J. G. PETERS, UNITED STATES FOREST SERVICE.

*Members of the North Carolina Forestry Association, Ladies and Gentlemen:*

The protection of our forests from fire is receiving increased attention throughout the country. It is the result not only of the enormous amounts of timber destroyed, but especially of the constantly growing value of timber. The loss in the coniferous forests of the North is frequently the destruction of the merchantable timber itself, while in the pine and hardwood forests of the South the chief damage is the repeated killing of young growth, especially on cut-over lands. This young growth has a very great future value, for upon it depends the permanency of the lumber industry in the region.

Fire also destroys the soil covering, causing rapid run-off on steep slopes and erosion is chiefly the origin of sediment in the channels of navigable streams. This injury to streamflow and navigation furnishes ground for active assistance from the Federal Government. A year ago Congress passed the Weeks law, section 2 of which is designed to authorize this assistance.

The purpose of this section of the law is primarily to protect navigable streams, and secondly to promote forest protection by the States and private owners. The appropriation for the purpose is \$200,000, which is available until expended. The law requires that (1) the protection must be confined to the forested watersheds of navigable streams; (2) the State must have provided by law for a system of forest fire protection; and (3) the Federal expenditure in any State must not exceed in any Federal fiscal year the amount appropriated by the State for the same purpose for the same fiscal year.

The law is administered by the Forest Service under an agreement between the Secretary of Agriculture and the State.

A broad interpretation has been placed on what constitutes a navigable stream, and in every case the stream is given the benefit of any doubt. However, streams used only for floating logs, canoes or rowboats are not consid-

ered navigable. As a general basis for decisions on the question of navigability the reports of the Chief of Engineers, United States Army, are used.

The work is being conducted on a conservative basis and the fund available for the purpose used so as to encourage local effort in as many different States as possible. The educational value of the work is very great, and the Government desires every State that can fulfill the requirements to receive a share of the fund. Our policy is to make the appropriation last three years. The expenditures in 1911 were practically \$39,000. The allotments for 1912 will aggregate about \$70,000. No State receives more than \$10,000 in any one year.

The aim is to assist each State as far as possible, helping especially the one that has a hard time helping itself. The State that can make only a small appropriation may have it duplicated, while the one that has an appropriation which is relatively very large and can of itself provide safe protection must expect a relatively small allotment.

The coöperative agreement provides that the State supply the Service with a comprehensive fire plan, including maps showing the areas to be protected, the headquarters and approximate routes of patrolmen, and all features necessary to a clear understanding of the State's plan of fire control.

The expenditures made by the Federal Government are exclusively for the salaries of patrolmen, including men assigned to lookout duty, railroad patrol, and the like. This is advisable in order to simplify the Federal inspection of the work. The expenditures of the State, which are to offset those of the Federal Government, may, however, properly include any expenditure for the purpose of protecting forested watersheds of navigable streams from fire. The construction of lookout stations or other protective facilities and proportionate amounts of supervisory expenses are proper charges on the part of the State against the expenditures made by the Federal Government. A distinction is made between State patrolmen and Federal patrolmen, which facilitates keeping separate the work charged to the State and that charged to the Federal Government.

The State Forester or similar officer is given a Forest Service appointment, which permits him to employ Federal patrolmen and certify to their services on Government vouchers. He is given as much authority and latitude as possible in the expenditure of Federal funds. The Forest Service places him in practically the same position as a National Forest Supervisor by allowing him a wide degree of discretion while at the same time making him fully accountable for results. He selects the Federal patrolmen, instructs them in their duties, and supervises their work.

The Federal patrolmen must have such police powers for the prevention and control of forest fires as the laws of the State provide; they must be authorized to employ assistance in fighting fires; and they must be equipped with fire fighting tools.

The Forest Service inspects the coöperative work on the protected areas, and can withdraw its approval of any area or terminate the employment of the State officer or any Federal patrolman.



The States which received Federal aid under the Weeks law in 1911, and the amounts expended by the Government and the States are shown in the following summary:

State	*State Expenditures	Federal Expenditures	Allotment to States	UNEXPENDED	
				Balance of Allotment	Balance of \$200,000 Fund Jan. 1, 1912
Maine.....	\$ 23,557.07	\$ 9,991.80	\$ 10,000.00	\$ 8.20	
New Hampshire.....	13,876.21	6,219.50	7,200.00	980.50	
Vermont.....	2,243.90	1,218.00	2,000.00	782.00	
Massachusetts.....	400.12	365.00	1,800.00	1,435.00	
Connecticut.....	513.96	6.00	1,000.00	994.00	
New York.....	3,837.59	2,000.00	2,000.00	0.00	
New Jersey.....	1,241.50	990.00	1,000.00	10.00	
Maryland.....	262.85	261.00	600.00	339.00	
Wisconsin.....	20,841.87	4,437.25	5,000.00	562.75	
Minnesota.....	25,675.77	10,000.00	10,000.00	0.00	
Oregon.....	8,758.89	3,305.00	5,000.00	1,695.00	
Total.....	\$ 101,209.73	\$ 38,793.55	\$ 45,600.00	\$ 6,806.45	\$ 161,206.45

\* As shown on State vouchers or statements forwarded with Federal vouchers. These vouchers are not necessarily the total State expenditures.

The watersheds that received coöperative protection were the following:

*Maine*—Narraguagus, Union, Penobscot, and Kennebec.

*New Hampshire*—Androscoggin, Saco, Connecticut, and Merrimac.

*Vermont*—Connecticut, Otter Creek, and Hudson.

*Massachusetts*—Nashua, Thames, Connecticut, Housatonic, and Hudson.

*Connecticut*—Thames, Connecticut, and Housatonic.

*New York*—Hudson and Delaware.

*New Jersey*—Hackensack, Passaic, Delaware, and Raritan.

*Maryland*—Potomac and Youghiogheny.

*Wisconsin*—Chippewa and Wisconsin (headwaters of the Mississippi).

*Minnesota*—St. Louis, Rainy, Mississippi, and Red River of the North.

*Oregon*—Columbia, Willamette, Nehalem, Wilson, Siletz, Umpqua, Coos, Rogue, and Klamath.

There were five hundred and nine Federal patrolmen employed, of which about two hundred were on continuous pay from the date of appointment to the end of the season. They received from \$2 to \$2.50 a day. Each had a district to guard varying in area from about 25,000 to 100,000 acres. Without necessarily attempting to cover the whole district he made his rounds of the dangerous places on the most valuable areas at the most advantageous times. The routes he followed varied from ten to forty miles a day, depending on the method of travel, usually on foot, horseback, or bicycle, whichever was the most feasible. Along the railroads, except where oil was burned, there was a special and continuous patrol, in some places on foot and in others on velocipede or bicycle.

The patrolman carried a map of his district and adjoining districts, showing the major topographic features, approximate location of the Federal and State patrol routes, patrolman's and fire warden's headquarters, and such improvements as telephone lines, lookout stations, roads, trails, tool supply boxes, and the like, as might be necessary to aid him in emergency. He also carried some fire fighting tool like a shovel or collapsible canvas pail.

The most important duties of the patrolman were putting out small fires, warning persons he met of the fire danger, and recording their names wherever advisable. In the case of larger fires, where assistance was necessary, he had authority under the State law to call out help to extinguish them.

Often fires were left unextinguished by camping parties; fishermen stopped to cook a meal and left the fire burning; many fires were also caused by smokers and locomotives. The patrolmen found hundreds of such fires as these on their routes last season and extinguished them.

In addition to regular patrol duty and fire fighting, there was other work, which included the watching for fires from lookout stations, burning slash, and constructing protective improvements.

Besides the practical tangible results of the coöperation under the Weeks law, which have been apparent from the start, its educational value, although not measurable, has been far reaching in effect. Except in a few States, last year was the first that any systematic patrol of the forests by the State had ever been done. It marked the general extension of the State organization, in coöperation with the Federal Government, getting out among the people; educating them, through the actual work done, in the need of fire protection, and soliciting their coöperation.

The most effective work of the patrolmen was in warning persons met in the woods of the danger from fire and informing them about the fire laws. The patrolmen were instructed generally to record the names and addresses of fishermen, hunters, and campers wherever possible, and send them to the district chief. In New Hampshire, for example, 4,200 warnings of this sort were given. Over half the names were recorded and are now on file in the office of the State Forestry Commission. Before the next fire season a copy of the fire laws will be sent to each of these persons. The educational value of this work can not be questioned.

The result of the warnings given and the other protective measures adopted is that the public is coming to know something about the forest fire laws of the State and the practical value of fire protection. Loggers and those who traveled the woods began taking greater care in the use of fire; quicker notifications of fire were given to the proper State officers, where before they had at best been desultory; in many cases private owners, who were skeptical at the start, later saw the practical value of the work and began contributing to it by the hire of patrolmen, building lookout stations, and the like; and the increased interest of the public was shown by the widespread demand for information on fire protection received by the various State foresters and the Federal Forest Service.

The first question that naturally occurs to one looking for measurable results is just how far the expenditures succeeded in saving possible losses. Maine and New Hampshire furnish very good examples of comparative losses in 1911 and 1903, two of the most dangerous fire years on record in these



States, on the watersheds where coöperative fire protection was established last year by the State and the timberland owners with the Federal Government.

Year	Season of Drought	MAINE		NEW HAMPSHIRE	
		Acres Burned	Damage	Acres Burned	Damage
1911 {	April 16—June 1	91,471	\$ 154,284	10,925	\$ 34,036
	June 20—July 17				
	April 17—June 6				
1903		172,040	679,423	84,255	200,000

While the danger season of 1911 was the longer, and was considered generally to be the more severe, still the area burned over and the value of the damage were considerably less than in 1903. This is very significant. The decrease can unquestionably be attributed largely to the protection afforded in 1911 as compared with the almost utter lack of it, except by some few private owners, in 1903.

The Federal Government desires to extend this coöperative protection to other States. To secure its benefits they must enact a forest fire law and appropriate funds for administering it. There are many States which could take hardly a more effective step toward the conservation of resources which support important industries than to inaugurate systematic fire protection. The fact that the immediate financial interests of timber owners make them backward in undertaking this insurance of their industry is an additional reason for the States to take the lead. The readiness of the Federal Government to coöperate with the States, under the terms of the Weeks law, as soon as they make a start is an incentive to immediate action.

A State fire law should provide, in addition to an organization to fight fires, a patrol force to prevent fires, as far as possible, from starting. The law should, of course, carry an adequate appropriation. A general defect in State forest fire laws is that they provide only for fighting fires and not for a patrol. Their most serious handicap is the inadequacy of the appropriations. To protect the national forests costs about two cents an acre annually; the Biltmore tract in this State, about five cents an acre; and the lands of the various timberland protective associations in the northeastern and northwestern States, from two to four cents an acre. It is probable that a State can secure efficient protection for one cent an acre, if the larger private owners will assist by contributing toward the protection of their own lands. If, for example, a State has five million acres that need protection, an annual expenditure of \$50,000 should be sufficient to handle the work effectively. It is improbable that the State would appropriate this amount at the beginning. An appropriation of \$10,000 or even less would be sufficient to start the work and demonstrate its value.

It will interest you to know what the States appropriate yearly for fire protection. Maine appropriates \$68,000, New Hampshire \$12,000, Vermont \$2,300, Massachusetts \$10,000, Connecticut \$2,000, New York \$100,000, New Jersey \$15,000, Pennsylvania \$50,000, Maryland \$1,500, Michigan \$10,000, Wisconsin \$35,000, Minnesota \$75,000, Idaho \$12,000, Washington \$38,000, and Oregon \$30,000.

I can not urge too strongly the adoption by North Carolina of a forest fire protective system with an adequate appropriation to meet its expenses. The State, which is so rich in timber resources, can then avail itself of the benefits offered by the Weeks law.

At the request of the President the discussion on Mr. Peters' paper was postponed until after the next paper, which gives a view of the same subject from the standpoint of one of the States which is now coöperating with the Federal Government in fire protection.

In the unavoidable absence of Mr. F. W. Besley, State Forester of Maryland, his paper was read by the Secretary. His paper follows:

### FOREST PROTECTION AS APPLIED IN MARYLAND UNDER THE WEEKS LAW.

BY F. W. BESLEY, STATE FORESTER OF MARYLAND.

The limited way in which Maryland has been able to participate in the benefits of the Weeks law has shown that it is a good thing and makes us anxious to do more along this line. Since forest conditions in North Carolina are somewhat similar to those in Maryland, our experience in this connection may have some suggestive value, at least.

In order that any State may take advantage of the coöperative offer of the Federal Government in fire protection, there are three conditions that must be fulfilled. First, the State must have adequate fire laws, giving full authority for inaugurating a policy of forest protection; second, there must be a suitable organization for carrying into effect these laws, that full benefits may be secured; and third, the State itself must appropriate money for the purpose of fire protection, as the Federal Government, under the Weeks law, will not, in any case, spend more money than the State spends for the same purpose during the same time.

There are certain other limitations upon the expenditure of the Federal allotments, such as limiting it to patrol and lookout station work, on the watersheds of navigable streams in the mountain sections, but under conditions that exist in Maryland and in North Carolina these limitations will probably not reduce the usefulness of the work.

Maryland has a good forest fire law and a forest warden system for putting the law into effect. The State has been expending about \$1,200 annually for forest fire protection, so that we were able to take advantage, to a small extent, of the Federal coöperation. An arrangement was made for the fall of 1911, whereby the State allotted \$600 and the Federal Government a like sum for fire protection. Seven mounted patrolmen were employed at three dollars per day to patrol on days when the woods were dry enough for fires to burn. The patrolmen were selected by the State Forester and worked under his direction, so that there was no interference whatever with the State forest organization. These men were selected with great care, for the work that they were called upon to do required tact in dealing with the mountain people. Furthermore, the number of patrolmen employed and the amount of money available was so small that close supervision was not practicable; hence the necessity of securing men that could be fully relied upon.



The fall of 1911 was unusually wet, so that the efficiency of the patrol work was not fully tested. Only eight fires were reported during the season. These were all small fires, discovered by the patrolmen soon after they started and promptly extinguished before any serious damage was done. The fact that these small fires were discovered and extinguished before they assumed serious proportions demonstrates fully the value of the patrol service. Under our forest warden system, the Forest Warden is not authorized to incur any expense in patrol work, or to do anything until after the fire has been reported to him, and, generally, the fire has done considerable damage and is difficult to control by the time it comes to the attention of the Forest Warden. Under the patrol system this trouble is largely overcome, and certainly for the mountain district, where there is a large percentage of woodland in continuous bodies, the patrol system is the practical method of dealing with the forest fire question. The State Forester outlined for the forest patrolmen and the regular State forest wardens, a plan of coöperation by which each was to work in harmony, and it is gratifying to report that this plan, so far as it could be observed under the limited opportunities for action this fall, worked out very satisfactorily.

#### EDUCATIONAL VALUE OF THE WORK.

Considerable stress was laid upon the educational feature of the work during the past season. The patrolmen were provided with printed matter relating to our forest fire laws and fire protection, and they were instructed to avail themselves of every opportunity to place this literature in the hands of landowners in their district and to talk with them on the subject of fire protection. While it is difficult to measure the effect of this work, it is believed that it has been instrumental in securing a more thorough coöperation on the part of the landowners of the mountains in suppressing forest fires. The landowners have, in every case, shown their willingness to co-operate, and now that their attention has been called to the forest laws, and the determination on the part of the State and Federal governments to aid them in securing fire protection, they have been encouraged to hold an entirely different view toward the forest fire question. It was just such work as this which was required to crystallize the sentiment and make it effective. The forest patrolmen not only visited the landowners in their districts, posted warning notices, and warned the careless, but also visited the schoolhouses and got the teachers interested. Our forest laws are sufficiently comprehensive to cover the situation and to meet any emergency that may arise, but it is just such an agency as this patrol which creates a public sentiment that will make their enforcement certain. The fact that the Federal Government is paying men to patrol the woodlands and enforce the forest fire laws carries with it a dignity and force which can not fail to arouse the admiration and good will of the people generally. I feel reasonably certain that these results have been secured in the Maryland work.

#### VALUE OF FEDERAL COOPERATION IN FIRE PROTECTION.

Under present conditions in Maryland, the State can not fail to appreciate fully the coöperation of the Federal Government. As has been stated, our forest laws are excellent in many respects. The Forest Warden Service has

been in operation for some time, but the whole system has shown its weakness in not making any provision for fire patrol and an utter lack of funds to carry on the protective work. The coöperation of the Federal Government, under the Weeks law, solves for us one of these great questions, namely, the forest patrol. Outside of the mountain counties the forests are generally held in woodlots, or isolated wooded tracts, where a fire patrol is less important. With the Federal coöperation, however, we are able to meet this situation without a change in our forest laws. The question, however, of increased appropriations for fire protection work is yet unsolved, but the fact that the Government has agreed to practically duplicate the amount we spend for fire protection purposes is the strongest kind of an argument that could be used for securing a special appropriation for forest protection from the Legislature this winter. The very limited amount that we had to expend has greatly curtailed the amount that could be secured from the Federal Government, but it has strikingly shown the need of extending the work.

A general discussion of the subject of coöperative fire protection under the Weeks law was then taken up, Mr. Alston Grimes and Mr. E. A. Blake of the Norfolk and Western Railway taking a prominent part. In answer to a question, Mr. Peters said that the implements of warfare in firefighting were the hoe, the rake, and the collapsible canvas bag. In regard to the pay we shall give to patrolmen, he said that various wages were paid, some receiving compensation by the hour, others by the month. He declared that volunteers are supported by the State and compensation to them varies from fifteen cents or twenty cents to fifty cents an hour.

Mr. Hugh MacRae, of Wilmington, then read an address on the "Stock Law and Forest Protection," prefacing his remarks with the statement that his subject was not a popular one, and giving as one of his reasons that men are not naturally lovers of effort.

### THE STOCK LAW AND FOREST PROTECTION.

BY HUGH MACRAE.

The question of Stock Law in its relation to forestry is so simple that it could be covered by a few emphatic sentences, but as this would savor of dogmatism and would not further the economic interests which we have met here to consider, I am going to ask you to let me surround the bare statement of facts with certain bits of information which I hope will emphasize the importance of this subject.

I shall speak of the longleaf pine forests of the coastal plain, because the problem there is simple and will serve very well to illustrate the subject. As to these forests of the coastal plain, could Nature have been more prodigal? Could we have been less appreciative? Here is a tree, the longleaf pine, of the very highest economic value, absolutely suited to soil and climate, which Nature insists on reproducing.



One growing or defective tree, left standing for two or three years after its fellows are taken, will reforest two or three acres of ground.\* The pine burrs begin to pop open on the coming of cold weather in October or November and scatter the winged seed or "mast," which is whirled in every direction by the prevailing winds of the winter. Almost every seed can germinate, for it falls on an ideal seed bed of sandy loam, which is kept almost constantly moist by the frequent rains.

After a few warm days the seed sprouts and puts down its small tap root. As soon as the tap root digs its way into the sand it performs one of the miracles of Nature by straightening up and lifting the mother seed into the air. Now the little tree is nourished from below and fed from above. It is fed through the tips of the pine needles until all proper dangers are passed; and with the warm days of spring it soon is six inches high, and by fall it is firmly established in the soil.

Compare this with the slow, expensive process of reforestation in Europe (with trees of far less value), where each tree is planted and replanted by hand.

It may be interesting to you to know that while I have been accustomed to going into the woods all my life, I never had the opportunity to observe the growth of the young longleaf pine from the seed, as above described, until after the stock law was passed in New Hanover County a few years ago. The hogs ran at large in that county and were so strenuous that they succeeded in making this phenomenon one rarely to be observed. Now you can see the longleaf pine reproduce itself everywhere.

Recently a gentleman from New York, who spoke Italian fluently, was questioning an Italian at St. Helena about the results obtained from the vineyards of the colony. It was noticeable that the Italian replied with great enthusiasm, and later when the gentleman was asked what was said he replied that there were no expressions in English to give the exact idea; but as near as he could express it the Italian said, "We can not understand why Nature has done so much for us, why she is so bountiful with the harvests. We feel that she has made a mistake."

The area of the coastal plain is somewhat in excess of ten million acres. If the value of reforestation is duly appreciated and the forests protected, there should be an increase of at least four million dollars per year to the value of the forests from the natural reproduction.

Can Nature do more for us in the way of providing forests? Why has she been so generous in soil and climate, in abundance of moisture? We can quite understand the Italian's point of view.

When we think of the vast areas of the earth's surface not adapted to reforestation and others where the forests, once destroyed, can not possibly be reproduced, we ought to be thankful and protect intelligently what has come to us as a gift.

At the moment we can not feel proud of the part man is playing. Because of ignorance and natural aversion to effort, he sets fire to the woods in order to give the benefit of the new growth of almost worthless grasses to almost worthless cattle, which are enabled thereby to get a scanty living. He ranges his hogs in the woods, when they would prove far more profitable if

\* A forester would recommend leaving at least one seed tree per acre, and preferably two, to make the reforestation from seed quicker and more sure.—Editor.

kept at home. From the time the pine mast falls\* until the little tree is one year old it affords a natural delicacy for the hogs—but only a delicacy, from the fact that a hog has to cover so much territory to live on this scattered food that he evolves into a high-speed brute, like Kipling's "kangaroo."

The fires and the hogs are enough to complete the destruction; but add to these a few sheep which have the habit of eating the conelike buds out of the tops, and the little trees, which have escaped other enemies, are killed.

Without being in possession of any figures obtained by scientific investigation, it might be safe to say that one fire-spreading man, with twenty hogs, twenty sheep, and ten cows, will keep ten thousand acres devastated.

Nature does not give up the fight, however. She attacks the hogs with cholera, the cows with tick fever, and the man with poverty; but with what terrific cost to civilization!

Let me tell you of one tract of ten thousand acres which reforested itself. The seeding period was fifty years ago when men were in the war and when hogs and cows were scarce. About one-half the timber on this tract is longleaf pine; the other half is shortleaf pine. The reforestation did not cost the owner one cent. As it came easily, it was sold cheap; land, timber and all for \$27,000. During the past five years this tract has paid the owners \$27,000 in turpentine rent; has paid to the renter more than \$100,000, I understand, in the value of the turpentine. The timber is worth at present stumpage prices over \$50,000; and on a good market would be worth more than \$75,000. The sawed value of the timber would probably be worth as much as \$500,000. As the land alone is worth much more than the purchase price, we can see that Nature's gift on this tract must be considerably in excess of \$200,000; or more than \$4,000 per year. While this land has probably been fire swept during recent years, the pine tree after it is several years old fortunately has a bark which will stand fire. The fire retards its growth, but does not kill the tree after the first few years.

A friend told me of an experience he had in the pine belt where there was no stock law. He bought about five hundred acres from which the pine trees had been cut. About six years ago he fenced ten acres of it. Recently he visited the place and found all the land outside of the fence just as he had left it years ago. Inside of the fence was a beautiful growth of longleaf pine, not less than one hundred trees to the acre. This man is naturally a strong advocate of stock laws which will protect the forest.

In this connection it is well to consider the worthlessness of woods cattle. This was brought home to me recently. Some parties joined in a plan to carry on a small cattle feeding and dairying experiment, which was to be enlarged if it proved a success. The manager was a Hollander who, while he understands cows, was a stranger to the cattle and methods of this country. He was struck with the cheapness of the woods cow and thought he could start with these and improve them. After feeding about forty head of woods cattle until they had about consumed their value in feed, and after going through the trials of tick fever and working with the cattle all fall and winter, it became perfectly clear that the wise thing to do was to dispose of them and start over again; and the owners were glad to sell the cows

\* Nearly all of the seeds of the longleaf pine are devoured by hogs before they have time to germinate. Those that by some lucky chance escape, and become seedlings, are rooted out, even after they reach several years of age, the succulent roots of the pine being relished by the hog.—Editor.



at their original cost price, losing one-half of the capital, which had been used up in expenses.

Do we want forests? Yes. Not only because of their economic value in furnishing fuel, crossties, and material for building and for the manufacture of furniture; but because they help to regulate the rainfall and conserve the water supply, which is essential to the prosperity of the agriculturist; and because the forests have a favorable influence on the climate, making it more equable by protecting the country against the sweep of cold winds.

In an article written by W. J. McGee, which appeared in a recent issue of the *World's Work*, it is made clear that the power of this country to support a very large population, one billion, with comfort, is directly measurable by the amount of available water supply—namely, the annual rainfall and that stored under the surface of the earth. He says: "The limit of our capacity for production and population lies not in the land or its living forms—both susceptible of immeasurable improvement—but in the supply of water on which life depends; for without water there are no plants, no soils, no animals, no men, no intelligence to control lower nature."

With the abundance of rainfall which we have in North Carolina, the great future of the country undoubtedly lies in the direction of intensive farming. If it is water and not land which sets the limits to population, and the chief feature in preserving our water supply is the care of our forests, then indeed we must handle this problem without delay. Twenty-five acre-feet of water per year on five acres of land will enable a family of five persons to support themselves with comfort and contribute to the support of an equal number of persons engaged in manufacturing or other kinds of work. With ample water, in other words, five acres will yield an easier living than 640 acres, or a square mile, on the plains; and eastern North Carolina will support easily one person per acre. In Holland there is a section where five hundred people are comfortably supported on fifty acres of land.

I wish I had the eloquence to demonstrate convincingly that because of this fact of abundant rainfall we of North Carolina live in one of the most favored spots on the globe; but we are not rising to the level of our natural surroundings. We are allowing generation after generation to go by and miss this miraculous opportunity. It seems that we must suffer by falling short of our birthright. It is common sense to proceed along the lines of least resistance, and to do the thing which can be done to greatest advantage.

We have met to consider ways of protecting the forests. It is obvious that forest fires must be avoided, and that ranging cattle and hogs must first be stopped.

The United States Department of Agriculture and the State Department make clear to us the great loss of profits to the farmer from tick fever and cholera, which are directly due to permitting scrub cattle and woods hogs to run at large. This information is interesting; but to be valuable we should apply the real remedy, which is the adoption of a *State-wide stock law*. If some of our farmers in certain sections are still too ignorant to be alive to their best interests, it is the duty of those who do understand this to insist that our Legislature shall take care of this matter. A development in one progressive line assists every other, and I think nothing will do more to help drainage projects, the building of good roads, better education, better home

comforts, and more profitable agriculture, than the passage of a stock law; and these things mean the development of our country.

A State stock law, then, means that a man shall keep his cattle, hogs, and sheep fenced in, instead of permitting them to roam at pleasure over the lands of other persons. If he owned sufficient land so that his hogs and cattle could range freely without interfering with others, we would not be so much interested in the problem; but even though this man owned land he does not have the rights over rainfall and climate. These are for the common good.

It is the function of good government to promote the welfare of the governed, to protect the weak against the unfair encroachment of the strong, and to do whatever is best for the interests of the majority of the people.

If forests are for the general good, and the protection of forests is advantageous to our civilization and necessary to our comfort, then we are justified in asking our Legislature, which should be composed of intelligent representatives and statesmen, to make the laws necessary for the protection of the forests.

Mr. MacRae's paper was listened to with profound attention, and was received with applause. In the discussion which followed Professor W. N. Hutt, of the State Department of Agriculture, stated that an unintelligent or "stand-pat" farmer had recommended to a more progressive one the rearing of hogs in the woods, as they could there get their own living. On being asked what he thought it cost per pound to raise such meat, the "stand-pat" farmer replied that he thought it cost nearly nothing. The progressive farmer, after showing the large amount of land that was run over by these hogs and the small amount of pork that was produced per acre and per one hundred dollars invested in this land, declared that in his opinion range pork cost three dollars per pound.

## REPORTS OF COMMITTEES

### REPORT OF COMMITTEE ON RESOLUTIONS.

Mr. C. P. Heyward read the report of the Resolutions Committee, which recommended the following resolutions:

#### RESOLUTION No. 1.

WHEREAS, The North Carolina Geological and Economic Survey has been commissioned by the Legislature to make investigations and recommend plans to the people and the Legislature for the improvement of the forest conditions of the State; and,

WHEREAS, The Survey has done and is doing as much as possible in this way with the limited amount of money at its disposal: be it

*Resolved*, That the North Carolina Forestry Association do endorse the work of the Survey, and do hereby show its appreciation of the assistance the Survey has given to this Association; and,



*Resolved further*, That we hereby memorialize the next Legislature to liberally support this branch of the work of the North Carolina Geological and Economic Survey.

## RESOLUTION No. 2.

WHEREAS, The Weeks Act provides an appropriation of \$200,000, available until exhausted, to enable the United States Government to coöperate with States in protecting from fire the forested watersheds of navigable streams; and,

WHEREAS, No State can take advantage of this offer of coöperation unless it has some paid system of forest fire protection: therefore, be it

*Resolved*, That the North Carolina Forestry Association urges upon the people of the State and upon their Representatives to the General Assembly who are to be elected during the coming summer the necessity of North Carolina's passing legislation which will enable her to receive this assistance from the Federal Government for the protection of her forests.

## RESOLUTION No. 3.

WHEREAS, We realize that a better understanding of the value of our forests and the need for more conservative methods in handling them has got to begin with the younger generation: therefore, be it

*Resolved*, That we hereby advocate the introduction into our schools and colleges of elementary courses in forestry, which will give the children of the State a better appreciation of the worth of these most valuable natural resources; and,

*Resolved further*, That we heartily second the efforts of the Federation of Women's Clubs to have a forestry course introduced at our State University; and,

*Resolved further*, That we heartily endorse the efforts of the North Carolina Geological and Economic Survey to make general the observance of Arbor Day in our public schools, and we do hereby respectfully request the State Board of Education to require the annual observance of Arbor Day by the schools of North Carolina.

## RESOLUTION No. 4.

WHEREAS, The annual yield from the forests of this State is exceeded only by the yield of cotton and corn; and,

WHEREAS, These forests are being cut at a much faster rate than they are producing timber, which will increase the demand for our second growth forests year by year; and,

WHEREAS, Forest fires annually destroy not only large amounts of merchantable timber, but also immense areas of young growth which ought to be reserved for the future use of our citizens: therefore, be it

*Resolved*, That the North Carolina Forestry Association advocates a State system of fire protection supported by an appropriation of the Legislature, to be administered by a technical and nonpartisan organization for the protection of all the timber lands of the State.

## RESOLUTION No. 5.

WHEREAS, A virulent fungus disease, known as the Chestnut Tree Blight, has already infected a large portion of the chestnut region of the New Eng-

land States, of New York, New Jersey, Pennsylvania, and Maryland; has entered and gained a foothold in Delaware, Virginia, and West Virginia, and threatens the destruction of this valuable timber tree in our own State; and,

WHEREAS, North Carolina and the other States not yet reached by the infection are justly entitled to every possible help and protection which Congress and the States themselves may be able to employ in saving their chestnut timber from attack: therefore, be it

*Resolved*, That the North Carolina Forestry Association pledges its support in arousing the public to recognize and combat this disease; and,

*Resolved further*, That this Association urges the Representatives of North Carolina in Congress to support a bill now pending before that body appropriating \$80,000 for the use of the United States Department of Agriculture, to be used in a thorough study and investigation of this tree disease, with the view of devising ways and means to combat its further spread, and to subject it to possible control.

*Resolved further*, That this Association bring this matter as soon as possible to the attention of the next General Assembly of North Carolina, with a view to making an appropriation, if then found advisable, towards protecting this State from this disease.

#### RESOLUTION No. 6.

WHEREAS, The indiscriminate ranging of stock through the open lands of both Eastern and Western North Carolina is a menace to the perpetuation of the forests of these regions through the destruction of the seed and young growth by stock, and because many of the forests fires indirectly result from this ranging: be it

*Resolved*, That the North Carolina Forestry Association heartily favors the extension of the stock law to those parts of the State which are now without this advantage.

#### RESOLUTION No. 7.

WHEREAS, Numerous fires are caused by sparks from locomotives: be it

*Resolved*, That the Legislative Committee be instructed to prepare a bill to be presented to the next General Assembly, requiring railroads to place spark arresters on all locomotives within one year after such act is passed; and,

*Resolved further*, That this Association request all civic clubs and similar associations to hold meetings with this object in view, and endeavor to pledge their Member of the General Assembly to support such bill when introduced.

#### RESOLUTION No. 8.

WHEREAS, The pine timber in many of the counties of the State has suffered enormous injury from the attacks of the Southern pine beetle, to the serious loss of the farmers and other timberland owners of the State; and,

WHEREAS, The United States Bureau of Entomology has studied this question thoroughly and worked out a method of control, which, if carried out, would free our State from this pest, and has advocated this plan both in the press and in public meetings in this State: be it

*Resolved*, That the North Carolina Forestry Association recognizes with appreciation the efforts of this Bureau to suppress this pest in North Carolina; and,



*Resolved further*, That this Association pledge its support to the further efforts of this Bureau and of the North Carolina Geological and Economic Survey, which is coöperating with this Bureau in this work; and,

*Resolved further*, That the question of more efficient coöperation through the Survey be brought to the attention of the next General Assembly, with the hope that an appropriation will be made to carry on this work more generally than they can now do.

These resolutions were unanimously adopted by the Convention.

#### REPORT OF COMMITTEE ON NOMINATIONS.

Miss Annie F. Petty reported for the Committee on Nominations, nominating the following gentlemen as officers for the ensuing year: Mr. E. B. Wright, of Bladen County, for President; Mr. J. S. Holmes, of Chapel Hill, for Secretary-Treasurer. The report of the Committee on Nominations was then adopted, and Mr. Wright was elected President, and Mr. Holmes was reëlected Secretary-Treasurer.

The constitution which had been drawn up and previously approved by the Executive Committee was then read by the Secretary, and was formally adopted by the Association.

### CONSTITUTION OF THE NORTH CAROLINA FORESTRY ASSOCIATION

*Name:* The name of this Association shall be the North Carolina Forestry Association.

*Object:* The object of this Association is to promote the protection of the forests of North Carolina from fire and from destructive insects, and to promote their perpetuation by wise use and by the reforestation of cut-over and abandoned lands.

*Office:* The official headquarters of this Association shall be located and maintained at the office of the Secretary.

*Membership:* The membership of this Association shall be composed of all who have registered with the Secretary and all those who may hereafter apply to the Secretary and have their names enrolled as members.

*Officers:* The officers of this Association shall consist of a President, a maximum of thirty-nine Vice-Presidents, one from each Senatorial District of the State, and a Secretary-Treasurer, who shall hold their respective offices for one year, or until their successors shall be duly elected and qualified. In the absence of the President or his inability to perform the duties of his office, the Vice-President for the district in which the meeting is held shall act in his stead.

*Executive Committee:* The Executive Committee shall consist of the President, the Secretary-Treasurer, and five other members of the Association, to be named by the President. At all meetings of this committee three members shall constitute a quorum for the transaction of business.

*Duties of Officers:* The President shall preside at all meetings of the Association and of the Executive Committee, and sign all orders on the Secretary-Treasurer, and perform all other necessary duties in furtherance of the purposes of this Association.

The Secretary-Treasurer shall keep the records, books, and accounts, shall be the custodian of the funds of the Association, and disburse the same upon the order of the President, and perform the other usual duties incumbent upon such office.

The Executive Committee shall have charge of the affairs of the Association pertaining to its business, provide ways and means for its proper finances, and perform all things necessary for the promotion of its interests.

*Meetings:* The annual meeting of the Association shall be held at such time and place as may be agreed upon by the Executive Committee. Notice of such meetings shall be mailed to each member of the Association at least two weeks prior to the date of meeting. Special meetings may be called by the President or by the Executive Committee.

The Executive Committee shall hold its regular, stated meetings at such times as it may select, and may adopt rules and regulations for the government of itself and the business of the Association.

Notice of special meetings as above provided for shall be mailed to each member of the Association at his last known post-office address at least ten days before the date of such meeting. Such notice shall set forth the object for which such meeting is called.

*Dues:* The annual dues shall be one dollar a year.

*Amendments:* These articles may be amended at any regular meeting of the Association by a majority of the votes cast.

The report of the Auditing Committee was made by Mr. D. A. White, approving the Treasurer's report.

This report of the Treasurer, for the year ending February 19, 1912, shows a total in receipts of \$102, disbursements \$52.25, leaving a balance on hand of \$49.75. Twenty-two subscriptions of one dollar each were received, the remaining eighty dollars having been given in two handsome donations by the John L. Roper Lumber Company and the Butters Lumber Company. The disbursements were all for stamps and stationery. The above balance will, however, be largely eliminated by the expenses of the Convention.

Several short talks were then made by delegates and guests of the Convention.

Mr. H. M. Cates, of Graham, N. C., representing the North Carolina Farmers' Alliance, said that he had been sent here to hear what was going on. "The farmers, I believe," he said, "are with you. I don't belong to your organization, but I have got my dollar with me and I am going to join. Our motto in regard to the forests seems to have been 'Take no thought for the morrow.' We have, however, got to protect our forests against the fires and careless men."

Mrs. R. R. Cotten, President of the North Carolina Federation of Women's Clubs, spoke of her intense wish for the perpetuity and continuity of the longleaf pine forests of the State. The women's clubs are



doing what they can to get forest preservation taught in the public schools. The women of the State are with this Association in this work.

Colonel J. Bryan Grimes spoke with force and conviction on the evidently increasing enthusiasm of the people in this matter. He declared that if there were one thousand farmers like Mr. Cates in North Carolina there would be a revolution in the State upon forest protection.

He called the attention of the men present to the ruthless destruction of the trees and even the lands, by the unintelligent handling of the timber when gotten out by the mill men. It destroys not only the undergrowth, the forests of tomorrow, but hurts the lands. He spoke of the trifling prices which timber had been sold at in the past. He asserted that we need education for our people and protection for our forests. We have seen Legislature after Legislature refuse to give laws for forest protection, because, he said, the laws that had been proposed did not seem to be what was needed for the various parts of the State. In concluding, Mr. Grimes moved that the President be requested to appoint a Legislative Committee to consult with the Attorney-General in outlining a law which will fill the needs for forest protection for the various parts of the State.

This motion was then put by the President, and was carried with enthusiasm. The following committee was subsequently named by the President: Mr. Alston Grimes, of Pitt; Mr. C. C. Smoot, III, of Wilkes; Mr. G. C. Speight, of Craven; Mr. Hugh MacRae, of New Hanover; Mr. Thomas A. Cox, of Jackson.

Ex-Governor Thomas J. Jarvis was then called upon by the President to say a few words. He said that he was glad to be present; that he made it a business to be present when there was anything for the good of North Carolina going on. He said that this meeting reminded him of the truism that the value of a gift is never really appreciated until it has slipped away from us. The people of North Carolina are in that condition. They have seen their forest wealth swept away and now they are beginning to take better care of the remnant. With properly directed efforts the forests may yet be preserved. They reproduce rapidly and with adequate laws to protect the forests the men who are now interested in this work can accomplish this end. The Governor said that he had been able to learn something at this meeting, and that he had come out to it as soon as he heard of it. He hoped that the Association would grow and increase in influence in order to protect the forests that are left and to secure others.

Mr. D. A. White, of Mebane, representing the Southern Furniture

Manufacturers' Association, said that his Association wished to coöperate with us in every way possible. His Association, he said, represents about two hundred factories, mostly in North Carolina, which are turning out furniture and allied articles. Mr. White gave a sketch of the furniture industry in North Carolina and spoke of himself as the father of the chair industry in the South. He was greatly interested in seeing the forests preserved and pledged the coöperation of the Southern Furniture Manufacturers' Association in the efforts of the Forestry Association to protect and preserve the forests of the State.

Mr. Z. W. Whitehead, of Wilmington, editor of the *Southern Lumber Journal*, spoke for the lumber fraternity and pledged their support in this movement. Thinking that the lumbermen as a class had been reflected upon in one of the talks, Mr. Whitehead defended the North Carolina lumbermen from the charge of vandalism. The average lumberman, he said, is not so ruthless as might be thought. He had found the sawmill men a great deal more conscientious than the fire vandal. The State suffers very much more from the firebug than from the acts of the lumberman.

The meeting was then adjourned, notice being given by the President of the illustrated lecture of Mr. J. G. Peters in the Auditorium at eight o'clock in the evening.

#### EVENING SESSION.

The evening session of the Convention was held in the Auditorium. In the absence of the President, Mr. J. S. Holmes, Secretary of the Association, introduced Mr. J. G. Peters, of the United States Forest Service, to an audience of something over two hundred people, including a considerable number of school children.

Mr. Peters then gave the following short introductory address on the general principles of forestry, which was followed by an illustrated lecture:

#### GENERAL PRINCIPLES OF FORESTRY.

BY J. G. PETERS, UNITED STATES FOREST SERVICE.

*Members of the North Carolina Forestry Association, Ladies and Gentlemen:*

The question is often asked, "What is Forestry?" which reminds me of an incident that happened soon after I arrived at New Haven to enter the Yale Forest School, something over ten years ago. Those were the early days, and the school had yet to graduate its first class. Walking across the campus I met a friend, then in college, from my home city, Baltimore. He wanted to know what I was doing up there, and I replied that I was studying forestry. "Forestry!" he exclaimed; "Forestry! for heaven's sake, what's forestry?" Although forestry is a much commoner word now than it was then,



still there is yet a generally vague idea of what forestry really is. In its broad meaning, forestry is simply the growing of trees for profit. Trees are considered as a crop of the soil, and the chief aim of forestry is to grow as much timber as possible in the shortest period of time.

In the practice of forestry a number of fundamental principles are considered. The first is that forests should eventually occupy only lands unsuited for agriculture. No forester will contend that rich soil, more profitable for growing agricultural crops, should be grown to trees. There are vast areas in forest in the South that are suited only for the production of timber; there are vast areas now in forest which will ultimately be used for agriculture; and also there are areas of cleared land that are better suited for the production of timber than for agriculture. Land should eventually be put to the use to which it is best suited. Real forest land should be kept in timber; real farming land eventually cleared. But, so long as any farming land remains forested it should be made to produce the largest possible amount of timber.

Another principle of forestry is that the amount of timber cut from a forest in a given period should not exceed the amount grown by the forest in that period; the forest is producing capital from which only the interest should be taken. Considerable cutting may be necessary for the improvement of the forest; many trees may be removed to give others a chance to grow, and low grade trees taking up valuable space may be eliminated.

Perhaps the greatest principle of forestry is that the cutting should be done in such a way that the forest will reproduce itself or, in other words, grow timber continuously.

Now, in order to practice forestry, and this is the point I wish to emphasize in particular, we must prevent the forest from burning up. Fire protection is a large part of the foundation on which the practice of forestry stands. Protection is the first law of forestry. Obviously it is unwise to make an investment in the form of conservative lumbering, or planting, or the like, if one is not reasonably sure that fire will not come along and destroy it. It has been estimated that the loss each year from forest fires in the United States averages more than 10,000,000 acres burned over and \$20,000,000 worth of property damaged or destroyed. In North Carolina the average yearly loss probably exceeds a half million dollars.

I am going to show a number of views which I have selected for the purpose chiefly of illustrating the good results from keeping fire out of the forest as compared with the great damage that may come through lack of protection. The first set of pictures will show virgin forests in North Carolina; the second set, the lumbering of the forest; third, the effects of fire and measures for prevention; fourth, the effects of erosion; and lastly, the practical application of the methods of forestry where fire and erosion have been prevented.

About seventy-five views, principally of North Carolina (furnished by the United States Forest Service), many of them colored, were then shown, and a short explanation made of each one by Mr. Peters.

This is the first illustrated lecture that has been given in Raleigh's new Auditorium, and so far as the Association is aware, is the first

public illustrated lecture on forestry given in Raleigh. The lantern used at the lecture was kindly loaned by Dr. Rankin, of the State Board of Health.

About seventy delegates were registered as in attendance on the convention, representing nineteen counties of the State, besides two delegates from Virginia. The following bodies were represented by delegates:

North Carolina State Federation of Women's Clubs, Southern Furniture Manufacturers' Association, North Carolina Farmers' Alliance, After School Club, North Carolina Pine Association, Mecklenburg Pine Beetle Association, Southern Pines Civic Club, Woman's Clubs of Raleigh and Greensboro, Chambers of Commerce of Raleigh, Greensboro, and New Bern, Norfolk and Western and Atlantic Coast Line railroads.

#### EXTRACTS FROM LETTERS RELATING TO FORESTRY

The following extracts from the letters of some of those who were invited to attend the Convention are here given, not only because they show the general and growing interest in the subject of forest protection, but also because they contain some valuable suggestions, and convey words of encouragement and sympathy.

Honorable H. S. Graves, Chief United States Forester, wrote:

"I appreciate very much your invitation to the annual meeting of the North Carolina Forestry Association on February 21st. I am awfully sorry that I can not accept the invitation, because it is going to be impossible for me to do more than meet the engagements which I already have ahead.

"If I were present I should call especial attention to the fact that under the present conditions the Southern States are not able to take advantage of the offer of the Government to aid in fire protection under the Weeks law. I think that this could be used as a very strong argument looking to fire protection under State direction."

Dr. Haven Metcalf, Pathologist in Charge, United States Bureau of Plant Industry, who was invited to address the Convention on the Chestnut Bark Disease, wrote:

"Your letter of the 7th was duly received, and I have given it very careful consideration. I regret very much that it is impossible for me to come myself, or send you a man for the meeting of your Association, as it seems necessary to have every one at Harrisburg who has any knowledge of the disease. I regret very much being unable to be present myself, as there is a good deal to be said on the subject of the chestnut bark disease, and I have little doubt that it will reach North Carolina by another year."

Honorable W. W. Finley, President of the Southern Railway, who was invited to address the convention on "The Close Relationship Be-



tween the State, the People, and the Railroads in the Prevention of Forest Fires," and who was prevented by sickness in his family, wrote in part as follows:

"I am, as you know, intensely interested in conservative forestry and the adoption of scientific methods of forest management throughout the South-eastern States. I believe it is of the utmost importance to our section that its forests should be so managed as to be a perpetual source of supply for raw materials for woodworking industries of all kinds. I am convinced that, with the upward tendency of lumber values, owners of forest lands will find it profitable to adopt conservative methods.

"If a suitable opportunity shall present itself during the sessions of the convention, I shall be glad to have you express my great interest in the whole subject and my regret that circumstances are such that I can not be present."

A telegram was received from the president of the John L. Roper Lumber Company as follows:

"Very much regret enforced absence from Forestry Convention. Consider your suggestion regarding fence law is of utmost importance to all land-owners as well as lumbermen. Wish you success.

(Signed)

"C. I. MILLARD."

Mr. F. W. Besley, State Forester of Maryland, wrote:

"The conference at Harrisburg on February 20-21, in regard to the chestnut bark disease, which conference I have agreed to attend, will not permit me to accept your very kind invitation to address the North Carolina Forestry Association at its regular meeting in Raleigh, February 21st.

"I have often felt that here in Maryland we are very much isolated in forestry work, as the States which are showing the most interest in forestry are the Northern States, in which the forest problems are quite different from those that exist here. It is, therefore, very gratifying to know that North Carolina is taking up the work so earnestly, and I hope that Virginia may do likewise before long. This gives us a certain bond of sympathy and community of interests that can not fully exist with the Northern States, which have problems so different from those we have in the South. This will be an added disappointment in not being able to meet with you in the discussion of the problems that are of mutual interest.

"I trust, however, that you may have a very interesting and profitable meeting, and that under the stimulus of the coöperative arrangement of the Weeks law that you may develop a plan which will be of great benefit to North Carolina."

Mr. L. T. Nichols, General Manager of the Carolina and Northwestern Railway wrote:

"I wish to assure you that we are heartily in sympathy with the work and are willing to coöperate with you in any manner our limited resources will permit."

But the citizens of our own State took no less interest than those from outside. A letter from the Secretary of the State Board of Public Charities, who is also a prominent clubwoman, is here given in full because it gives a good idea of what the women of the State have done, are doing, and are willing to do for the cause of forestry education.

"I thank you for the appointment as a delegate to the annual meeting at Raleigh. I shall take pleasure in attending the sessions.

"You know that the State Federation of Women's Clubs (about three thousand women) are interested in the subject of Conservation, and that there is a Forestry Committee in that Federation. This committee consists of Mrs. W. G. Smith, chairman, Asheville; Mrs. T. P. Harrison, President of the Raleigh Woman's Club, Raleigh; Miss Adelaide Fries, Winston-Salem; Mrs. W. J. Cocke, Asheville, and Mrs. W. G. Rogers, Charlotte. Mrs. W. J. Cocke, of Asheville, is the most interested and was chairman for three years, but we have time limits in our appointments and so she was obliged to be put on as a member merely, and the time limit took me off. But we have not lost our interest, and Mrs. Cocke as chairman last year tried to get a Chair of Forestry established at the University. I have the very beautifully written resolutions passed by the Federation in favor of this chair and the report. Mrs. Cocke had letters from Governor Kitchin, Judge Clark, Senator Simmons, Hon. J. Y. Joyner, Senator Overman, Judge Pritchard, Hon. W. C. Dowd, Governor Newland, and Dr. Joseph Hyde Pratt, endorsing the movement for a Chair of Forestry. A number of papers also wrote in favor of it, and the only trouble seemed to be *funds* sufficient for the new departure. It is probable that an endorsement by the Forestry Association of this movement coming from the Federation would greatly help the ladies and would serve as a bond between the working forces in the two organizations.

"Wishing you much success.

(Signed)

DAISY DENSON."

Three of our State Senators wrote as follows:

"I thank you very much for the invitation, and if I had not already made an engagement for that date, I would most certainly be with you. I am greatly interested in the question of forestry, and while I was abroad last summer I studied the modes, ways and means of the great German Empire and her great forests and posted myself about this great question which America must very soon take up and take up in earnest.

"Trusting that your meeting will be a success in every way, I am,

"Very sincerely yours,

A. H. BOYDEN."

"I regret very much that it is impossible for me to attend the Forestry Convention which is to meet in Raleigh on the 21st, owing to court which I can not neglect. I thoroughly and deeply sympathize with the movement, and had hoped to be able to contribute some of my services to the worthy work being done in the country. With highest regards and very best wishes, I am,

"Yours truly,

J. FRANK RAY."

"I hope you will have a successful meeting which will result in a great deal of good in the protection of our forests. If there is any aid that I may be able in the future to give along this line I will be glad to do so.

"Respectfully,

J. C. FISHER."



Two prominent lawyers wrote:

"I am heartily in sympathy with this movement, as I can see where great good will result to the country by concerted action taken by the Association to check the destruction of so much forest by forest fires in this State.

(Signed)                      GEORGE H. SMATHERS."

"This is one of the most vital matters which affect the interest of our people. It was only a few nights ago that I saw the forest fires in the mountains near here, which was a very sickening sight.

"While I can not be personally present with you, you have my sympathy and influence, whatever it may be, and will try and meet with you on some future occasion.

(Signed)                      A. M. FRYE."

The Vice-President of the Southern Power Company wrote:

"I regret very much that I will not be able to attend the Forestry Association meeting at Raleigh on Wednesday, the 22d, as I have to be in New York at that time. I wish, however, every success to the organization, and I am glad to note that the people in this section here are taking a great deal more interest in this matter.

(Signed)                      W. S. LEE."

And one of the State's foremost educators wrote:

"I appreciate your appointment of me as a delegate. I had hoped that my engagements would allow me to attend, but I find to my regret that it will be impossible.

"With all good wishes for the success of your important work,

(Signed)                      WM. LOUIS POTEAT,

*"President Wake Forest College."*





# FOREST FIRES IN NORTH CAROLINA DURING 1911

BY J. S. HOLMES, FORESTER.

## INTRODUCTION

During the past three years the State Geological and Economic Survey has collected statistics on the extent of the damage done by forest fires in North Carolina. These figures for 1909, collected in coöperation with the United States Forest Service, together with a short study of the various kinds of injury done by fire, an inquiry into the common causes of fires and a few suggestions as to the best methods of preventing and extinguishing forest fires were published by the Survey as Economic Paper No. 19. The statistics for 1910 which were collected by the Survey alone, were published as Economic Paper 22, "Forest Fires and Their Prevention." This publication also contains a review of some of the educational and legislative measures which are calculated to help reduce the fire risk, the State law on the subject of forest fires which is now operative, as well as three proposed laws. A limited number of both bulletins are still available for distribution.

The figures on forest fires for 1911 have been gathered in the same way as in previous years, *i. e.*, from voluntary correspondents. Many of the earlier correspondents have dropped out, while others have been added to the list. The valuable assistance rendered by the North Carolina Forestry Association, which furnished complete lists of correspondents for about one-fourth of the counties of the State, has added considerably to the accuracy of the figures, though until such lists can be obtained for every county no attempt at completeness can be claimed for these statistics.

The object in collecting and publishing these figures is not to give exact information on the subject, as under present conditions that is impossible, but to draw the attention of the general public to the extent of the damage done by forest fires, with the hope of gradually bringing about better conditions.

## THE WEATHER

As the weather is one of the chief factors in the fire risk, a glance at weather conditions during 1911 is here given.

The United States Weather Bureau thus summarizes conditions for the past year:

"The year was an exceptional one in temperature and precipitation. A number of records were broken. The average annual precipitation, 42.68

inches, was less than any previous record; a peculiar coincidence in this connection is the fact that the four driest years of record have been at intervals of seven years, viz: 1890, 1897, 1904, and 1911. \* \* \* There was a marked deficiency in precipitation from January to October 10th, with the exception of a very slight excess in April and August, but it was somewhat above normal during the remainder of the year. During the summer and early fall the water supply was affected in some localities, but the distribution of precipitation, in slight showers, was generally sufficient for surface requirements."

These well distributed showers also served to assist in keeping down the damage done by forest fires, which, gauged by precipitation alone, should have been more disastrous in 1911 than ever before. As a matter of fact, many counties, especially in eastern North Carolina, did suffer very seriously, the newspapers reporting excessive damage in March, April, June, and July. Unfortunately, figures from many of the counties which have suffered the most in eastern North Carolina have not been secured, so that the statement for this year is decidedly incomplete.

#### TABULAR STATEMENT

From the following tables it will be seen that the returns have been very incomplete, only one-third of the townships being reported on in any way. The remaining townships have no doubt men in them who would be willing to assist in this effort to educate the public towards better treatment of our forests, but they have not offered to help and their names have not been suggested by friends of the movement.

If this is read by any who would be willing to help, it is hoped that they will notify the Forester, North Carolina Geological and Economic Survey, Chapel Hill, N. C., who will be only too glad to secure their coöperation in the future.



TABLE 1.—FOREST FIRES IN NORTH CAROLINA DURING 1911. COMPARATIVE STATEMENT. SUMMARY OF REPORTS FROM CORRESPONDENTS BY REGIONS, FOR 1911, 1910, AND 1909.

	Mountain			Piedmont			Coastal Plain			State		
	1911	1910	1909	1911	1910	1909	1911	1910	1909	1911	1910	1909
Total number of townships in region.....	166	166	-----	450	450	-----	364	364	-----	980	980	-----
Number of townships reporting.....	59	51	-----	161	146	-----	112	131	-----	332	328	-----
Number of replies received.....	70	48	47	179	142	61	119	131	50	367	321	158
Number of forest fires reported.....	189	136	249	249	258	86	199	312	272	637	706	607
Total area burnt over, in acres.....	41,100	80,825	166,295	32,424	158,948	100,670	86,725	339,780	139,100	100,225	579,553	406,065
Total standing timber destroyed in M ft. bd. measure.....	10,639	6,915	17,325	4,496	12,553	11,027	23,418	42,550	9,280	38,550	62,018	37,632
Value of timber destroyed in dollars.....	\$ 36,440	\$ 25,095	\$ 47,520	\$ 12,997	\$ 35,930	\$ 33,374	\$ 64,621	\$108,995	\$ 26,360	\$114,060	\$170,020	\$ 107,254
Area of young growth destroyed, in acres.....	7,252	7,190	13,100	16,623	55,712	14,555	40,190	78,735	27,050	64,065	141,637	54,705
Value of young growth destroyed, in dollars.....	\$ 12,380	-----	-----	\$ 20,325	-----	-----	\$ 78,250	-----	-----	\$110,955	-----	-----
Value of forest products destroyed, in dollars.....	\$ 44,680	\$ 28,215	\$ 17,075	\$ 41,045	\$100,415	\$ 39,425	\$ 90,233	\$129,545	\$ 30,245	\$175,955	\$258,175	\$ 86,745
Value of improvements destroyed, in dollars.....	\$ 10,410	\$ 19,375	\$ 26,550	\$ 16,120	\$ 25,615	\$ 14,750	\$ 21,200	\$ 53,805	\$ 17,105	\$ 47,730	\$ 98,795	\$ 58,405
Total damage reported, in dollars.....	\$103,910	\$ 72,685	\$ 91,145	\$ 90,490	\$161,960	\$ 87,549	\$254,300	\$292,345	\$ 73,710	\$448,700	\$526,990	\$ 252,404
Number of lives lost.....	-----	1	-----	-----	1	-----	1	3	-----	-----	5	-----
Cost to private individuals to fight fire.....	\$ 1,965	\$ 13,155	\$ 6,650	\$ 2,327	\$ 10,503	\$ 1,059	\$ 6,790	\$ 11,780	\$ 6,355	\$ 10,780	\$ 35,438	\$ 14,064

TABLE 2.—FOREST FIRES IN NORTH CAROLINA DURING 1911. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.

## MOUNTAIN REGION.

COUNTY.	Total No. of Townships in County	No. of Townships Reporting	No. of Replies	No. of Fires.	Total area burnt over	Merchantable Timber Destroyed, M	Value of Timber Destroyed	Area of Young Growth Destroyed, in Acres	Value of Young Growth Destroyed	Value of Products Destroyed	Value of Improvements Destroyed	Lives Lost	Cost of Fighting Fire
Alleghany.....	8	1	2	10	100	50	\$ 200	50	\$ 200	\$ 400	\$ 500	--	\$ 50
Ashe.....	15	1	1	0									
Avery.....	7	2	3	2	300	500	500	200	200	400	2,000		
Buncombe.....	13	5	5	10	1,300	30	120	400	50	200	200		100
Cherokee.....	6	3	5	93	5,800	50	75	1,100	100	1,175	50		110
Clay.....	5	2	2	2	1,000	40	60	200	400	1,000	100		150
Graham.....	3	1	1	0									
Haywood.....	13	4	4	7	3,750	30	120	150	1,300	1,500	150		150
Henderson.....	8	3	3	3	200								5
Jackson.....	15	3	2	13	3,200	30	150	200	100		25		50
Macon.....	11	3	3	4	2,200								
Madison.....	16	13	14	17	10,450	7,784	24,590	3,550	4,200	35,185	6,175		510
Mitchell.....	9	5	5	6	300			150	200				100
Swain.....	5	2	3	3	10,000	2,000	10,000	1,000	5,000	4,000	1,000		500
Transylvania.....	9	3	3	3	50			2	30				10
Watauga.....	12	2	4	0									
Yancey.....	11	6	10	16	2,450	125	625	250	600	820	210		230
Total.....	166	59	70	189	41,100	10,639	\$36,440	7,252	\$12,380	\$44,680	\$10,410	--	\$1,965



TABLE 3.—FOREST FIRES IN NORTH CAROLINA DURING 1911. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.

## PIEDMONT REGION.

COUNTY.	Total No. of Townships in County	No. of Townships Reporting	No. of Replies	No. of Fires	Total area burnt over	Merchantable Timber Destroyed, M	Value of Timber Destroyed	Area of Young Growth Destroyed, in Acres	Value of Young Growth Destroyed	Value of Products Destroyed	Value of Improvements Destroyed	Lives Lost	Cost of Fighting Fire
Alamance.....	13	3	3	0			\$		\$	\$	\$		\$
Alexander.....	8	5	5	2	120	5	15	120	1,100	300			70
Anson.....	8		0										
Burke.....	11	1	1	0									
Cabarrus.....	12	4	7	2	200	50	200	100	50	500	100		40
Caldwell.....	12	3	1	0									
Caswell.....	9	3	3	0									
Catawba.....	8	6	8	1	35	25	30	10	50				
Chatham.....	14	4	3	4	145	100	200	20					
Cleveland.....	11	10	13	7	190	375	1,225	50	600	1,500	5,000		
Davidson.....	17	1	1	1	2					2,000			
Davie.....	7	6	10	4	115		100	25		200			
Durham.....	6	1	1	1	200								
Forsyth.....	14	3	3	1		35				420	1,000		
Franklin.....	10	6	6	91	1,585		300	900	2,100		5,050		525
Gaston.....	6	2	3	2	600								
Granville.....	9	5	7	4	200	100	500	100	500	1,500			
Guilford.....	18	2	2	0									
Iredell.....	16	4	4	10	795	166	517	360	1,425	25,800	1,000		200
Lee.....	7	4	3	4	525	320	1,000	310	3,050	200	1,000		225
Lincoln.....	5	3	3	0									
McDowell.....	10	3	4	7	225	50	200	10	100	100			
Mecklenburg.....	15	7	8	2	3			3	75				
Montgomery.....	11	3	3	1	500	15	75	100	100	425	20		5
Moore.....	9	3	3	8	10,000			10,000					50
Orange.....	7	1	2	3	5						50		2
Person.....	9	2	2	0									
Polk.....	6	6	5	42	7,500			500	500				50
Randolph.....	19	4	3	2	2,000	2,000	4,000	1,500	3,000				200
Rockingham.....	11	2	2	0									
Rowan.....	14	7	8	5	410			200	2,000				50
Rutherford.....	12	5	2	0									
Stanly.....	8	2	2	5	306	150	300	150	1,025	2,500	1,000		
Stokes.....	8	2	2	1	500		2,000			2,000			
Surry.....	14	9	13	9	3,063	555	660	50	50		1,000		205
Union.....	9	1	1	0									
Vance.....	8	2	2	0									
Wake.....	19	1	1	3	150			100	500				
Warren.....	12	2	2	2	200	50	175	100	200	600			25
Wilkes.....	20	15	17	19	2,750	500	1,500	1,840	3,300	3,000	600		700
Yadkin.....	8	8	10	6	100			75	500		300		
Total.....	450	161	179	249	32,424	4,496	\$12,997	16,623	\$20,325	\$41,045	\$16,120		\$2,327

TABLE 4.—FOREST FIRES IN NORTH CAROLINA DURING 1911. SUMMARY OF REPORTS FROM CORRESPONDENTS BY COUNTIES.

## COASTAL PLAIN REGION.

COUNTY.	Total No. of Townships in County	No. of Townships Reporting	No. of Replies	No. of Fires	Total area burnt over	Merchantable Timber Destroyed, M	Value of Timber Destroyed	Area of Young Growth Destroyed, in Acres	Value of Young Growth Destroyed	Value of Products Destroyed	Value of Improvements Destroyed	Lives Lost	Cost of Fighting Fire
Beaufort.....	6	2	2	15	11,000	1,000	\$ 3,000	11,000	\$34,000	\$ 1,000	\$ 5,000	—	\$ 250
Bertie.....	9	5	6	5	850	110	300	325	650	500	550	—	110
Bladen.....	15	3	3	13	5,400	2,700	5,000	6,350	11,150	5,000	500	—	—
Brunswick.....	6	4	3	11	8,500	5,025	22,050	7,500	10,000	25,000	200	—	325
Camden.....	3	—	0	—	—	—	—	—	—	—	—	—	—
Carteret.....	9	—	0	—	—	—	—	—	—	—	—	—	—
Chowan.....	4	3	2	2	100	0	—	100	1,000	—	—	—	25
Columbus.....	14	3	5	5	1,200	300	900	1,200	2,200	1,350	1,000	—	1,000
Craven.....	9	2	5	2	300	150	600	—	—	—	—	—	50
Cumberland.....	11	4	4	8	510	—	—	—	—	3,000	—	—	65
Currituck.....	5	3	3	0	—	—	—	—	—	—	—	—	—
Dare.....	5	—	0	—	—	—	—	—	—	—	—	—	—
Duplin.....	13	5	2	10	1,500	600	1,300	1,300	800	1,300	500	—	150
Edgecombe.....	14	1	1	0	—	—	—	—	—	—	—	—	—
Gates.....	7	1	2	15	2,000	0	—	1,500	—	2,000	—	—	300
Greene.....	10	2	2	4	1,000	20	100	500	5,000	15,000	—	—	100
Halifax.....	12	—	0	—	—	—	—	—	—	—	—	—	—
Harnett.....	13	6	7	8	3,000	75	225	50	200	1,000	—	—	50
Hertford.....	6	2	3	8	700	300	1,200	200	200	2,000	550	—	225
Hoke.....	5	1	1	0	—	—	—	—	—	—	—	—	—
Hyde.....	4	2	3	2	2,000	100	250	1,100	1,000	—	500	—	—
Johnston.....	16	10	9	8	500	2,500	4,890	575	900	2,000	3,000	—	1,000
Jones.....	7	1	1	1	5,000	50	100	—	—	100	—	—	—
Lenoir.....	12	4	4	6	2,150	100	300	150	1,500	5,000	—	—	500
Martin.....	10	—	0	—	—	—	—	—	—	—	—	—	—
Nash.....	12	8	8	8	645	70	300	505	425	—	50	—	—
New Hanover.....	4	—	0	—	—	—	—	—	—	—	—	—	—
Northampton.....	9	3	4	4	5,010	2,500	5,000	10	100	—	50	—	110
Onslow.....	5	3	3	14	10,000	630	800	3,200	900	75	475	—	350
Pamlico.....	4	3	2	2	5,000	250	500	2,500	500	2,000	200	—	500
Pasquotank.....	6	2	2	0	—	—	—	—	—	—	—	—	—
Pender.....	10	1	1	1	9,000	1,500	4,500	—	—	—	—	1	—
Perquimans.....	5	1	2	0	—	—	—	—	—	—	—	—	—
Pitt.....	11	4	6	15	2,325	1,120	3,250	525	1,625	16,700	1,200	—	750
Richmond.....	7	1	1	4	500	—	—	—	—	500	5,000	—	500
Robeson.....	19	8	7	19	5,425	4,090	9,160	3,400	6,100	4,500	1,225	—	105
Sampson.....	16	4	4	3	900	8	16	—	—	1,008	—	—	25
Scotland.....	4	1	1	0	—	—	—	—	—	—	—	—	—
Tyrrell.....	5	—	0	—	—	—	—	—	—	—	—	—	—
Washington.....	4	1	2	1	2,000	—	—	—	—	—	—	—	300
Wayne.....	12	4	4	2	—	—	—	—	—	—	—	—	—
Wilson.....	10	4	4	3	210	220	880	200	—	1,200	1,200	—	—
Total.....	364	112	119	199	86,725	23,418	\$64,621	42,190	\$78,250	\$90,233	\$21,200	1	\$6,790



FOREST FIRES AND THEIR PREVENTION.  
TABLE 5.—COMPARATIVE STATEMENT OF AVERAGES BY REGIONS FOR 1911, 1910 AND 1909.

	Mountain			Piedmont			Coastal Plain			State		
	1911	1910	1909	1911	1910	1909	1911	1910	1909	1911	1910	1909
Percentage of townships reporting.....	35	31	668	36	32	---	30	36	---	335	33.5	---
Average area of each fire, in acres.....	217	594	668	130	616	1,171	436	1,089	511	250	821	667
Average damage by each fire, in dollars.....	\$ 5.50	\$ 6.31	\$ 3.93	\$ 3.63	\$ 6.68	\$10.30	\$12.78	\$ 9.74	\$ 2.94	\$ 7.05	\$ 7.75	\$ 4.39
Average area burnt over per township reporting, in acres.....	697	1,585	---	201	1,089	---	774	2,594	---	483	1,805	---
Average damage per acre burnt, in dollars.....	\$ 2.53	\$ 1.06	\$ .59	\$ 2.79	\$ 1.08	\$ .88	\$ 2.93	\$ .90	\$ .57	\$ 2.80	\$ .97	\$ .66

From the foregoing tables it is seen that the number of fires reported is practically the same as for the two previous years, and most of the other figures correspond fairly closely, showing that the annual damage from forest fires is not decreasing at any appreciable rate. The most notable thing about these figures is the reduction in the amount of land burned over by each fire, and, consequently, the large total reduction in area burned over, this being less than one-third of what was burned in 1910.

The total amount of damage done by the fires that were reported is estimated at \$428,000, which is less than the damage for 1910, but considerably more than that given for 1909. The average damage per acre has largely increased, being \$2.80 for the whole State. One reason for this large increase is that the figures for 1911 include estimates of damage done to young growth, which were not included in the earlier figures.

One remarkable thing about these figures is the comparative uniformity of the reports coming from the different regions of the State, showing that they are not the result of exaggerated ideas of a few correspondents, but represent the opinion of the average citizen of North Carolina.

Though some sections of the State were singularly free from fires during the past year, others suffered extreme injury. This is especially true of some of the eastern counties, several of which have unfortunately failed to report. The accounts of fires, appearing in the daily papers last summer, which occurred in Carteret, Dare, Pasquotank, Perquimans, Tyrrell and other counties, none of which are reported here, makes one realize that the figures given are much below the actual amount, and convinces one that strong measures should be taken at once to reduce this enormous annual loss.



## CAUSES OF FOREST FIRES

The principal causes of forest fires as given by the various correspondents for their own townships have been compiled. They are given in percentages in Table 6, and are compared with similar figures for the two preceding years.

TABLE 6.—CAUSES OF FOREST FIRES IN THE DIFFERENT REGIONS OF NORTH CAROLINA IN 1911 COMPARED WITH FORMER YEARS, IN PERCENTAGES.

	1911				1910	1909
	Moun- tain	Pied- mont	Coas- tal	State	State	State
Farmers burning brush, grass, rubbish, etc.....	17	16	9	13	13	10
Hunters.....	17	6	10	10	6	16
Cigars, cigarettes, matches, etc.....		4	4	3	3	3
Carelessness and negligence of individuals.....	16	25	20	20	20	15
Railroad locomotives, sparks from.....	10	19	31	22	20	17
Logging locomotives, dummy engines, etc.....	7	6	13	9	9	5
Sawmills, etc.....	3	8	3	4	5	3
Traction engines.....					1	
Accidental, caught from burning buildings, etc.....					1	1
To improve the range.....	3	2		2	3	4
Set by chestnut gatherers, root diggers, etc.....	7			2		2
Without much object, to see it burn, etc.....	3			1	2	13
Malice or incendiary.....	10	2	3	4	9	4
Unknown causes.....	7	8	3	6	8	7
Lightning.....		4	3	3		
Fishing camp fires.....			1	1		

The two most notable facts that can be gathered from the above table are: (1) The large proportion of fires which are started from farmers carelessly burning brush, grass, and rubbish in the spring; (2) the large and increasing percentage of fires started by railroads.

As can be seen by a glance at the first four items in the table, fires caused by carelessness and negligence of the individual constitute about one-half of the total causes given. Practically all of the fires under the fourth heading should be attributed to one of the three former causes and probably most of them to the carelessness of farmers in clearing up farm land in the spring. It is this carelessness of farmers and renters, assisted by the usual high winds and frequently by dry weather, that makes the spring months by far the most dangerous, fires at this time of the year being more frequent and much more destructive than at any other season.

The following table, compiled from replies from the correspondents to the question "In what month or months did the worst forest fires occur

(in 1911)?" indicates pretty clearly what is the danger season in North Carolina.

TABLE 7. RELATIVE FIRE RISK IN 1911, BY MONTHS AND SEASONS, IN PERCENTAGES.

March	14	} Spring 57	June	9	} Summer 26
April	27		July	10	
May	16		August	7	
September	7	} Fall 14	December	2	} Winter 3
October	4		January	0.5	
November	3		February	0.5	

The largest number of fires attributed to any one cause are laid to sparks from railroad locomotives, twenty-two per cent being attributed to this cause, an increase of two per cent over the year 1910, and of five per cent over the year 1909. This increased proportion is still greater if the logging railroads are included. Forty-four per cent of all the fires in the Coastal Plain region are attributed to locomotives, while in the mountain counties this number is reduced one-half. The great increase of the proportion of railroad fires may be due rather to the reduction of the number of fires from other causes than to the actual increase in the number of fires from this cause. It is evident, however, that the railroads are a great menace to the forests of the State, and a determined effort both on the part of the people and on the part of the railroads should be made to remedy this evil. A suggested law for the suppression of forest fires which is reprinted from Economic Paper No. 22 is given herewith, with the hope that the intelligent public will study this matter, and will call the attention of their next representatives in the General Assembly to their need of such laws. The protection of the forests from fire depends first of all upon the people. If they want to stop the frequent and destructive fires, the State Government will help them; that is what it is for. But they must show in some way that they desire such assistance, and they can do that best by appealing to their representatives.



## SUGGESTED FORESTRY LEGISLATION

The following chapter was prepared for and published in Economic Paper No. 22, "Forest Fires and Their Prevention." This bulletin has been distributed so widely over the State that the original edition is nearly exhausted.

As the question of Forest Fire laws will no doubt occupy the attention of many people during the coming political campaign and subsequently, it is hoped, of the entire Legislature also, it has been thought best to publish the part of this paper relating to present proposed forest fire laws as a part of Economic Paper 25 rather than reprint the whole of Economic Paper 22, much of which is superseded by the report on forest fires for 1911 which is included in this present bulletin.

The proposed laws are given not as legislation which must be adopted or rejected as a whole, but rather as suggestions to aid in the formation of public opinion, and possibly as a basis from which to build a much needed law which may be adapted to all portions of our State. It may be said of the railroad law, however, that it was highly commended by the Federal Forest Service, and during the session of the last Legislature it firmly withstood the criticisms of the more important railroads of the State.

### PRESENT LAWS RELATING TO FORESTRY

In 1777 the General Assembly of North Carolina passed a statute making it unlawful for any one to set fire to the woods; except it be his own property, and in that case not without first giving two days notice in writing to adjoining property owners. After one hundred and thirty-four years this law still remains on our statute books, the best and practically the only law we have on the subject. In its present form in The Revisal of 1905 it reads:

SECTION 3346. *Woods*.—If any person shall set fire to any woods, except it be his own property or, in that case, without first giving notice in writing to all persons owning lands adjoining to the woodlands intended to be fired, at least two days before the time of firing such woods, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands near to or adjoining the lands so fired, he shall, for every such offense, forfeit and pay to any person who shall sue for the same, fifty dollars, and be liable to any one injured in an action, and shall moreover be guilty of a misdemeanor.

The law, therefore, forbids setting fire to woods, even though it be one's own property, without giving two days notice in writing to adjoining landowners. This law is rarely enforced, because the "two days notice in writing" is considered an impractical measure, and also because the strong objection among most people to prosecuting their neighbors acts as a deterrent. One of the most frequent causes of fire, that from burning brush while clearing up new grounds in the spring, is not covered by this law, for the courts have held that these "new ground" fires do not come within the stat-

ute. This law is susceptible of considerable improvement and should be amended.

Since the great extension of railroad facilities all over the State, the practice of hauling farm crops and merchandise long distances to market, which used to be the universal custom, has almost ceased. In the rougher and more remote parts of the State, however, where more than one day's trip is required to reach the market, the abandoned campfire is still a menace. That North Carolina has a law against leaving such fires unextinguished is often not known by wagoners, and a notice quoting the following section posted near frequented camping places would often be of great advantage to the passerby, as well as a safeguard to the property owner:

3347. *Woods, from Camp Fires.*—If any wagoner or other person encamping in the open air shall leave his camp without totally extinguishing the camp fires, he shall be guilty of a misdemeanor, and upon conviction thereof, shall be fined not exceeding fifty dollars, or imprisoned not exceeding thirty days.

These two laws, the most important dating back some one hundred and thirty years, constitute the present working forest fire laws of North Carolina. Even these, however, are rarely enforced.

### SUGGESTED LEGISLATION RELATING TO FORESTRY

As we have previously seen, the largest number of fires are due to the carelessness or indifference of individuals, and to the negligence of railroads, lumbermen, and other operators of engines. In order to successfully cope with this situation, we need: (1) Better laws to control the private citizen; (2) stricter regulations controlling the railroad and other engine users; (3) a system maintained by the State, or the State and counties together, to properly enforce the forest fire laws. These three features may be combined in one act, as was done in the bill which was introduced into the last Legislature, or they may be passed as three separate acts, as is here proposed.

*Fires Set by Private Individuals.*—The present law, which has previously been given, should be amended to include grassland, but the two days written notice required should apply to woods only, or should be eliminated altogether. By broadening the second section to make it include hunters and other persons, some approach to controlling that fertile source of forest fires would be made.

In New Jersey and several other States to the north and west of us, the burning of woods, brush, stumps, rubbish, and other material is not allowed during a dry season, and in some cases throughout the year, without a written permit from the proper officer. This has been found to work well in preventing fires, especially the destructive early spring fires. In North Carolina, however, we are hardly ready for such a law. A law to compel all who burn material to watch it till it is extinguished would seem to meet a definite need and would be more easily enforced.

The following suggested bill contains all of the above features:

A BILL TO BE ENTITLED AN ACT TO PROTECT THE FORESTS OF THIS STATE FROM FIRE.

*The General Assembly of North Carolina do enact:*

SECTION 1. That section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five be amended to read as follows:



If any person shall set fire to any grassland, brushland, or woodland, except it be his own property, or, in that case, without first giving notice to all persons owning or in charge of lands adjoining to the land intended to be fired, and also taking care to watch such fire while burning and taking effectual care to extinguish such fire before it shall reach any lands near to or adjoining the land so fired, he shall for every such offense be guilty of a misdemeanor and be fined or imprisoned in the discretion of the court. This shall not prevent action for damages sustained by the owner of any property.

SEC. 2. That section three thousand three hundred and forty-seven of The Revisal of one thousand nine hundred and five be amended to read as follows: Any wagoner, hunter, camper or other person who shall leave a campfire without fully extinguishing it, or who shall accidentally or negligently, by the use of any torch, gun, match or other instrumentality, or in any manner whatever, start any fire upon any grassland, brushland or woodland, without fully extinguishing the same, shall be guilty of a misdemeanor, and upon conviction shall be punishable by a fine of not less than twenty-five dollars nor more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 3. All persons, firms or corporations who shall burn any tar kiln or pit of charcoal or set fire to or burn any brush, grass or other material where-by any property may be endangered or destroyed, shall keep and maintain a careful and competent watchman in charge of said kiln, pit, brush or other material while burning. Any person, firm or corporation violating the provisions of this section shall be guilty of a misdemeanor.

*Railroad Fires.*—The railroads and lumber companies, though great offenders, having caused probably one-third of the fires in the State in 1910, are also great sufferers, being generally held responsible for injury and made to pay damages. A few of the replies to the question asking about prosecutions are here quoted: "Railroad paid for several acres of timber"; "Railroad compromised, nothing done about the rest"; "No; the railroad people always pay damage"; "The railroad has paid about \$1,000"; "No; railroad company paid about \$2,000"; "The railroad company goes over the ground and sees how much it burns over, and pays about thirty-five cents per acre"; "Set by traction engine, and damage paid"; "Lumber company sued for \$5,000"; "Lumber company forced to pay damages"; "Suit entered against one lumber company." These prosecutions are, of course, as said before, brought under the civil law, and do not invoke the present fire laws. They do, however, show that it is as much to the interest of the railroads as to that of the owners of woodland that fires should be prevented. Until there is some general demand, however, that the railroads take necessary precautions, they prefer to drift along in the old way, paying damages now and then—the average cost of which they know—rather than advocate new laws, which, though they might save them money, still would cost them an unknown amount to carry out. When reasonable laws are once passed the railroads will undoubtedly coöperate actively in their enforcement, trusting thereby to cut down their large annual bill of damages.

During the last session of the Legislature the following bill was drawn up, after careful discussion and criticism of every point by the representatives of the people and of the railroad and lumber companies. It was at first introduced as part of the general forestry bill, but was later drawn up as a separate law. It is in this form that its passage by the next Legislature is strongly urged.



A BILL TO BE ENTITLED AN ACT TO REQUIRE THE RAILROADS OF THE STATE TO TAKE CERTAIN PRECAUTIONS FOR THE PREVENTION OF FOREST FIRES.

*The General Assembly of North Carolina do enact:*

SECTION 1. All persons, firms or corporations operating any railroad, logging road or tramroad through woodland within this State shall keep their right of way cleared of all combustible materials within a horizontal distance of one hundred (100) feet, nowhere to exceed one hundred and fifty (150) feet surface measurement, from the outer rail on each side of the track, by burning or other method. Combustible material, as referred to in this act, shall be construed to mean only such brush, grass, leaves or other material that would ordinarily become ignited from a spark from the engine. When the right of way owned does not extend to the width of the cleared space or fire line herein required, the right is hereby granted to said persons, firms or corporations to enter upon adjoining lands not owned by them, for the purpose of clearing off and maintaining the cleared space or fire line herein required. If any landowner should object to the clearing off and maintenance of the fire line herein required, he shall not be entitled to collect any damages thereafter occurring from fires caused by sparks from the engines of said persons, firms or corporations. Each railroad, logging road or tramroad affected hereby shall be required to clear off each year not more than one-fifth (1-5) of the total length of the fire line required by this section until all has been completed, and shall continue to keep such fire line clear after it has once been cleared off. The part of the mileage to be cleared off by such railroad shall be designated by the Geological Board after conference with the proper officer of such railroad, logging road or tramroad. Any railroad wilfully violating the provisions of this section shall be liable to a penalty of not less than ten (\$10.00) dollars nor more than twenty-five (\$25.00) dollars for every mile or fraction thereof of fire line not cleared according to the provisions of this section: *Provided*, that this section shall not be construed to prohibit or prevent any railroad company from piling or keeping upon the right of way, cross-ties or other material necessary in the operation or maintenance of such railroad or materials intended for shipment over such railroad; nor is it intended to require the removal of buildings, fences or other necessary or valuable improvements from the fire line herein required: *Provided further*, that the notice to the adjoining landowners required by section three thousand three hundred and forty-six of The Revisal of one thousand nine hundred and five shall not apply to any burning necessary to carry out the provisions of this section: *Provided, further*, that nothing in this section shall be construed to require the railroad company to clear the fire line on property not owned by said company should the owner object, and no failure on this account shall be charged against the railroad company as a violation of this act.

SEC. 2. When engineers, conductors or trainmen employed by any railroad discover that fences or other material along the right of way or woodland adjacent to the railroad are burning or in danger from fire, they shall report the same promptly at the next telegraph or telephone station at which the train is scheduled to stop, or at any other stops necessary in the operation of the train. The reporting of such fires shall not be construed to mean that the railroad companies making such report are responsible for such fires, nor shall such report be used in evidence in a suit arising from such fire, but is simply for the purpose of giving information as to the existence of a fire. In seasons of drought the railroad companies shall give instructions to their section foremen for the prevention and prompt extinguishing of fires originating on their right of way, and they shall cause warning placards, furnished by the Geological Board, to be posted at their stations in the vicinity of forest lands. Any railroad company wilfully violating the requirements of this section shall be guilty of a misdemeanor, and railroad employees wilfully violating the requirements of this section shall be guilty of a misdemeanor.

SEC. 3. For the purpose of this act woodland is taken to include all forest areas, both timber land and cut-over land, and all second growth stands on areas that have at one time been cultivated.



This law requires the railroads to clear off a strip one hundred feet wide on each side of their track, where it runs through woodland. It has been demonstrated after careful study that most of the live sparks from railroad locomotives fall within the zone between fifty and one hundred feet on each side of the track, and very few fall beyond that distance. Keeping this strip clear would then prevent most of the fires caused by railroads and logging roads, which, as we have seen above, constitute about one-third of the fires in the State.

*Fire Warden System.*—The most important problem in the formulation of forest laws is providing effective machinery for putting them into force. Eighteen States have already organized fire protective systems, the purpose of which is to enforce the forest fire laws of these States. Little or nothing has been accomplished in States without such systems, though several, like our own, have some excellent laws. A fire warden system generally consists of district, township, or county wardens, who, as a rule, are responsible to some one State official, either the State Forester, the State Forest Commissioner, or State Fire Warden, who is specifically charged with fire-protective work and usually also with the forestry work of the State. It is the duty of the wardens to extinguish fires, arrest offenders against the fire laws, investigate the causes of fires, post warning notices against fire, and in some cases to patrol the forests during dry weather. They are paid by the State, or by the county, or by the State and county combined, usually by the hour or day, for the time actually employed. In fixing a rate of payment, care is taken not to make it high enough to tempt unscrupulous men to set fire to the woods with the object of drawing pay for extinguishing it. This practice may, of course, be occasionally resorted to, even where the pay is not high, but an efficient county fire warden would soon discover the perpetrators, or at least have his suspicions aroused, and one or two drastic sentences, upon conviction, would put a stop to the practice. There are many counties in North Carolina where fire wardens are not needed, but in counties having fifty per cent and over of their area in woodland they would quickly pay for their cost. If only a few counties were given the advantage of such a law to start with, the demand for fire wardens would rapidly spread, as their usefulness became apparent. The following bill, in a somewhat different form, was introduced into the Legislature of 1911, but failed to pass, chiefly because a special tax of half a cent per acre on all woodlands in the State was asked, to provide revenue for its enforcement. This method of raising the necessary money is perfectly fair and equitable, but until the system can be inaugurated and tested in those counties that most need fire protection, it is thought that a direct appropriation would be much simpler and more practicable.

A BILL TO BE ENTITLED AN ACT TO AUTHORIZE THE APPOINTMENT AND PAYMENT OF FOREST WARDENS.

*The General Assembly of North Carolina do enact:*

SECTION 1. On petition of four or more owners of timber lands in any one township, owning in the aggregate five thousand acres or more, or the owners of one-third of the forest land in the township, the county commissioners shall appoint, subject to the approval of the Geological Board, a forest warden for that township and as many deputy forest wardens to act with him as the Geological Board may deem necessary for the proper enforcement of this act. All forest wardens and deputy forest wardens must be legal residents of the counties in which they are employed.

SEC. 2. Forest wardens and deputy forest wardens shall have charge of measures for controlling forest fires; they shall make arrests for violations of the forest laws; shall post along highways and in other conspicuous places copies of the forest fire laws and warnings against fires, which shall be supplied by the Geological Board; and they shall perform such other duties as shall be considered necessary by the Geological Board for the protection of forests. The forest wardens of the township in which a fire occurs shall within ten days make such report thereof to the Geological Board as may be prescribed by them. Each deputy forest warden shall promptly report to wardens any fire in his district.

SEC. 3. Any person who shall maliciously or wilfully destroy, deface, remove or disfigure any sign, poster or warning notice, posted by order of the Geological Board under the provisions of this or other act for the purpose of protecting the forests in this State from fire, shall be guilty of a misdemeanor and upon conviction shall be punishable by a fine of not less than ten dollars or more than fifty dollars or imprisoned not exceeding thirty days.

SEC. 4. Any person discovering any forest fire shall immediately give notice to the nearest forest warden or deputy forest warden in that or adjoining townships. All ablebodied male persons between eighteen and forty-five years of age can be summoned by forest wardens or deputy forest wardens to assist in extinguishing forest fires and shall be paid for such services at a rate not to exceed fifteen (15) cents per hour. Any person summoned by a forest warden or his deputy and not attending, without reasonable excuse, shall be subject to a fine of five (\$5) dollars.

SEC. 5. Forest wardens and deputy forest wardens shall have the same power as deputy sheriffs, so far as the provisions of this act are concerned. Neither forest wardens nor their deputies shall be liable for trespass while acting in the performance of their duties, nor shall any person be held guilty of trespass for going on lands when summoned by an officer to control fire.

SEC. 6. Forest wardens and deputy forest wardens shall receive compensation from the State at the rate of twenty cents per hour for the time actually engaged in the performance of their duties and reasonable expenses for equipment and transportation incurred in fighting or extinguishing any fire, according to an itemized statement to be rendered the Geological Board every month and approved by them. Forest wardens shall render to the Geological Board a statement of the services rendered by the men employed by them or their deputy wardens, as provided in this act, within one month of the date of service, which said bill shall show in detail the amount and character of the service performed, the exact duration thereof, the name of each person employed, and any other information required by the Geological Board. If said bill be duly approved, it shall be paid by direction of the Geological Board out of the State Treasury; and the State Treasurer is hereby authorized and required to collect one-half of the wages and expenses incurred by the forest wardens and deputy forest wardens under this section and section three (3) of this act, from the county in which they are incurred.

SEC. 7. The sum of ten thousand dollars annually is hereby appropriated, out of any moneys in the treasury not otherwise appropriated, for the purpose of carrying out the provisions of this act, the same to be drawn upon as directed by the Geological Board.



PUBLICATIONS  
OF THE  
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

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BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands, and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Waterpowers in North Carolina, by George F. Swain, Joseph A. Holmes, and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and Other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesium Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents. Cloth-bound copies 30 cents extra.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglas B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Waterpowers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*
23. Forest Conditions in Western North Carolina, by J. S. Holmes, 1911. 8°, 115 pp., 8 pl. *Postage 15 cents.*

## ECONOMIC PAPERS.

1. The Maple Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal, in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Mineral and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.



15. *The Mining Industry in North Carolina During 1907*, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. *Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina*, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. *Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908*. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. *Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909*, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. *Forest Fires in North Carolina During 1909*, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. *Wood-using Industries of North Carolina*, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. *Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified)*. Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. *Forest Fires in North Carolina During 1910*, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Postage 3 cents.*

23. *Mining Industry in North Carolina During 1908, '09, and '10*, by Joseph Hyde Pratt and Miss H. M. Berry, 1911. 8°, 134 pp., 1 pl., 27 figs. *Postage 10 cents.*

Gives report on Virgilina Copper District of North Carolina and Virginia, by F. B. Laney; Detailed report on Mica Deposits of North Carolina, by Douglas B. Sterrett; Detailed report on Monazite, by Douglas B. Sterrett; Reports on various Gem Minerals, by Douglas B. Sterrett; Information and Analyses concerning certain Mineral Springs; Extract from Chance Report of the Dan River and Deep River Coal Fields; Some notes on the Peat Industry, by Professor Charles A. Davis; Extract from report of Arthur Keith on the Nantahala Marble; Description of the manufacture of Sand-lime Brick.

24. *Fishing Industry of North Carolina*, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

25. *Proceedings of Second Annual Convention of the North Carolina Forestry Association, held at Raleigh, North Carolina, February 21, 1912*. Forest Fires in North Carolina During 1911. Suggested Forestry Legislation. Compiled by J. S. Holmes, Forester, 1912. 8°, 71 pp. *Postage 6 cents.*

26. *Proceedings of Fourth Annual Drainage Convention, held at Elizabeth City, North Carolina, November 15 and 16, 1911*, compiled by Joseph Hyde Pratt, State Geologist, 1912. 8°, .... pp. *Postage .... cents.*

27. *Highway Work in North Carolina, containing a Statistical Report of Road Work during 1911*, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, 1912. 8°, .... pp., .... figs. *Postage .... cents.*

#### VOLUMES.

Vol. I. *Corundum and the Basic Magnesian Rocks in Western North Carolina*, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. *Fishes of North Carolina*, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. *The Coastal Plain Deposits of North Carolina*, by Wm. Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson, and Horatio N. Parker, 1912. 8°, 509 pp., 62 pl., 21 figs.

Pt. I.—*The Physiography and Geology of the Coastal Plain of North Carolina*, by Wm. Bullock Clark, Benjamin L. Miller, and L. W. Stephenson.

Pt. II.—*The Water Resources of the Coastal Plain of North Carolina*, by L. W. Stephenson and B. L. Johnson. *In Press.*

## BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report. Contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract, Buncombe County; Transylvania County State Farm; certain Watersheds; Reforestation of Cut-over and Abandoned Farm Lands; on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county seats in North Carolina; list of Magnetic Declination at the county seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

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Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump



form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*





NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

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ECONOMIC PAPER No. 26

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## PROCEEDINGS

OF

## FOURTH ANNUAL DRAINAGE CONVENTION

HELD AT

ELIZABETH CITY, NORTH CAROLINA

November 15 and 16, 1911

Compiled by  
JOSEPH HYDE PRATT



RALEIGH  
EDWARDS & BROUGHTON PRINTING CO., STATE PRINTERS  
1912





## LETTER OF TRANSMITTAL

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CHAPEL HILL, N. C., May 5, 1912.

*To His Excellency, HON. W. W. KITCHIN,*

*Governor of North Carolina.*

SIR:—There was held at Elizabeth City, N. C., on November 15 and 16, 1911, a convention that was not only of very great interest to this State but its deliberations have attracted national recognition. This was the Fourth Annual Drainage Convention, which was held under the auspices of the North Carolina Drainage Association and the North Carolina Geological and Economic Survey. On account of the importance of this convention, I recommend that its proceedings be published as Economic Paper No. 26 of the publications of the North Carolina Geological and Economic Survey.

Yours respectfully,

JOSEPH HYDE PRATT,  
*State Geologist.*

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# PROCEEDINGS

OF THE

## FOURTH ANNUAL DRAINAGE CONVENTION

HELD UNDER THE AUSPICES OF THE

### NORTH CAROLINA DRAINAGE ASSOCIATION

AND THE

### NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

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COMPILED BY  
JOSEPH HYDE PRATT, STATE GEOLOGIST

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#### INTRODUCTION

There recently closed at Elizabeth City the Fourth Drainage Convention held under the auspices of the North Carolina Drainage Association, and it was undoubtedly the most successful convention that this Association has yet held.

The amount of work that has been accomplished since March, 1909, when the North Carolina drainage law was passed, was a surprise to a great many of the delegates. Fifty-three drainage districts have been established, or are in the process of organization, embracing over 700,000 acres of swamp and overflowed lands. While it has been known for years that the swamp lands of eastern North Carolina were the richest of all the lands in that part of the State, yet certain difficulties were in the way of draining these satisfactorily and making them available. Their reclamation has been talked of for the last fifty years, but it was not until the organization of a North Carolina Drainage Association that definite steps were taken to bring to a head the various theories and arguments as to how the work should be done. The result is as above stated.

The two days' session of the convention were full of interesting information regarding drainage work and the time was taken up largely in the discussion of various problems and difficulties which had come up in the drainage of certain areas, and these discussions were perhaps as interesting and instructive as any part of the convention.

The convention was fortunate in having Mr. C. G. Elliott, Chief of the Drainage Investigations of the United States Department of Agriculture, in attendance. He gave a very interesting and valuable paper on "Some Essential Features of Drainage in North Carolina." This address was listened to with the greatest attention by the delegates, and opened a line of discussion on several subjects. Mr. Elliott prefaced his remarks by stating that the department is extremely pleased with the

work that is being done in North Carolina in drainage and that a considerable part of the country had their eyes on this State, watching the progress she is making in the development of her swamp lands.

This Drainage Convention was held under the auspices of the North Carolina Drainage Association and the North Carolina Geological and Economic Survey, and all the counties of the Piedmont and Coastal Plain sections of the State were invited to send delegates. These delegates were appointed by the Governor, mayors of cities, county commissioners, and commercial bodies. The following counties were represented: Beaufort, Chowan, Columbus, Craven, Cumberland, Currituck, Duplin, Edgecombe, Lenoir, Mecklenburg, New Hanover, Orange, Pasquotank, Perquimans, Robeson, Rowan, Sampson, Washington, and Wilson.



## PROCEEDINGS OF THE CONVENTION

MORNING SESSION—NOVEMBER 15, 1911.

At 10:30 o'clock in the courthouse at Elizabeth City, the Fourth Annual Drainage Convention of the North Carolina Drainage Association was called to order by Joseph A. Brown, President, who called on Rev. E. W. Stone, pastor of the First Baptist Church, to make the opening prayer.

The address of welcome was made by Rev. C. F. Smith on behalf of Hon. J. B. Flora, mayor of Elizabeth City.

## ADDRESS OF WELCOME

BY REV. C. F. SMITH.

*Mr. President and Gentlemen of the Convention:*—Having been reared at the plough handles, so to speak, and knowing something of the nature of farming from infancy, it is a great pleasure to a man of that kind to come into a convention of people such as this.

It is a great privilege to me to stand before you and represent our Mayor and give you a welcome to our city. Elizabeth City is less out of the world now, on account of the railroad system, than it has been in many years, or than it ever has been before. We are glad to have you come into our town, and we want you and all North Carolinians to know our town. We believe that you are going to bring to us great good, that you will do us great good. We believe that you have among you men who understand the great problem of drainage. Most men know how to dig a hole, but not every man knows how to dig a ditch. Maybe he knows how to dig some kind of a ditch, but not the ditch of the proper width and depth.

Elizabeth City citizens will understand me when I say that we live where there is too much water. Not that we want something else in the place of water, but we want it in its proper place. We do not object to other things in their proper places, to other drinks in their proper places, but we want them in the proper place. We hope and believe that you will be able to place this surplus water in its proper channels for us.

It was a great pleasure to me in a recent journal to see the great progress that has been made in this drainage work. We have seen something of the work done in Tyrrell County, and all of us have crossed the canal between here and Norfolk. It is a great surprise to find how many drainage organizations there are in this State. The work is going on, and I hope that you have come here to increase our interest and our enthusiasm in this work. I welcome you. I welcome you for the Mayor in the name of the city. I simply give you that welcome, be at home; take charge of the town. If it needs draining, tell us how to do it. We have mud, but we are putting bricks down. We believe that "charity begins at home," and we hope the work of drainage will begin at home. We hope to see the good work carried out successfully. We welcome you most heartily.

The response to the address of welcome was made by President Brown:

#### PRESIDENT'S ADDRESS

BY JOSEPH A. BROWN.

*Mr. Mayor:*—I am sure I represent each man in this audience when I say we accept your generous hospitality as becomes North Carolinians.

A few days ago I was in the city of New Orleans. On going to my room at the hotel I received a call over the long-distance telephone. Some one over in Mississippi said, "Are you Mr. Brown?" I replied, "Yes." He asked, "From North Carolina?" I replied, "Yes." He said, "I just want to hear the voice of one more North Carolinian." I said, "Come on back to North Carolina."

I have never had the pleasure of visiting your city before. After twenty years experience in our State Legislature I have learned to know many of our best citizens, but they always told me that you had to go out of the State to get to Elizabeth City. I was mighty glad and agreeably surprised, however, to be able to get on a Pullman car at Goldsboro last night and get off at Elizabeth City this morning. I like to go up on our western mountains and look toward the east. A friend of mine called me one morning to get up and go up the mountain to see the sun rise. I did, and as I looked down over the valley, the little streams looked like streaks of bright, beautiful silver. I was looking towards the east. I am getting to that time of life when I like to look toward the east and not toward the west, because the west suggests the going down of things. I believe that there is a very great future for Eastern North Carolina in the next decade. But the development of this must come largely through systematic drainage, and it is to discuss this that this convention has met here in Elizabeth City.

Three years ago the North Carolina Drainage Law was enacted. It is a short period, and yet we have organized or there is in process of organization in North Carolina fifty-two drainage districts, involving an outlay of \$3,000,000 to \$3,500,000. Our people have taken on new life and it means much for the future, especially to eastern North Carolina. Some of us make the mistake of calling this association one for the reclamation of swamp land, which is true, but it was also organized to assist in the reclamation of overflowed lands; and to show the advantage of farm tile drainage.

I assure you, Mr. Mayor, that we are glad to come here and accept your open-handed hospitality. We are going to take the town and treat it as ours. The bright little girl of my own household, who is just taking up the study of Colonial history, when she heard I was coming to Elizabeth City, said: "That is near Edenton—I wonder if you will be invited to a tea party." I must confess that I had not associated Elizabeth City as being out here on an oyster reef in the sound, but—I am glad I find it in the midst of a prosperous section. I had felt before like this section belonged to Virginia, but I am glad to know that you can now travel from Manteo to Murphy and not have to leave your own State to get to your own capital.

I am going to assume the rôle of the prophet, though I know such a rôle is a dangerous one, and say that before this generation shall have passed, Eastern North Carolina will be one of the granaries of this country. I belong to that class of men who believe that Providence has a great guiding hand in all



that is done. North Carolina is, perhaps, more interested in the price of cotton today than everything else combined. I believe that the result of the low price of cotton this year will teach men the lesson of development and will teach men that we can make both hog and hominy in North Carolina as well and as cheaply as they can in Illinois.

A few days ago a gentleman who lives in my town, and who was formerly a resident of the great State of Illinois, went West to settle his father's estate, the land of which was sold for \$165 per acre. I asked him how much corn it would produce. He replied that the estimation of the entire crop was seventy bushels per acre, bringing forty cents per bushel—twenty-eight dollars per acre yearly. I have never seen the time in the most depreciated period of the history of North Carolina that corn would sell for less than sixty cents per bushel. But eastern North Carolina is different from our section, my friends. We have to get corn and hay from Kansas to feed our stock with. And yet we have made rapid strides. The people of North Carolina may well feel proud when they consider the prostrate condition we were left in forty years ago, when we gathered up the parched corn that dropped from the mouths of the horses. Well may North Carolina be proud of its great empire of noble men and women. The thrift and energy and independence that they have shown makes them second to no State in this nation.

We are glad to be among you of eastern North Carolina. We appreciate your hospitality, and trust our deliberations may be of interest and assistance to you, in your problem of drainage.

At the close of the address of welcome the President declared the Convention open for regular business, and called on the Secretary, Joseph Hyde Pratt, for his report.

### SECRETARY'S REPORT

BY JOSEPH HYDE PRATT.

I wish to submit, as the Secretary's report of the last meeting of the convention and of the Association, a paper published by the North Carolina Geological and Economic Survey, as Economic Paper No. 21, on the "Proceedings of the Third Annual Drainage Convention." In addition, I wish to say a few words regarding the drainage work in North Carolina.

In the first place, I want to call your attention to the object of the North Carolina Drainage Association. It is given on the first page of today's program—"to promote the drainage of swamp and overflowed lands in North Carolina."

The North Carolina Drainage Law, as it was passed by the General Assembly of 1909 and amended by the General Assembly of 1911, is so framed that it is just as applicable to the overflowed lands of the Piedmont section as it is to the swamp lands of eastern North Carolina. We have, then, in our Drainage Association, a bond that is linking Piedmont North Carolina and eastern North Carolina closer and closer together. When we first took up the question of drainage, every one in central and western North Carolina said, "That is simply a proposition to drain the swamps; we know nothing about it, and it does not concern us." We ran up against the same propo-

sition in connection with the fish and oyster problem, and that is a condition that has existed for years and years, that western North Carolina knew very little about eastern North Carolina. Even Piedmont North Carolina knew very little about eastern North Carolina. Our Drainage Association, however, is drawing together Piedmont and eastern North Carolina and doing as much to bring these sections together as perhaps the railroads that are giving us now such excellent connection and service.

I can remember very distinctly when I first came down into this section of the State. How did I come? I took the Southern Railroad to Norfolk, making a portion of the trip through Virginia, and then came down on the train to Elizabeth City. I was going to another section of North Carolina, to New Bern. I went to Norfolk, then came down to Elizabeth City, and took the through boat at night to New Bern. But now we can go through from Piedmont North Carolina into almost any part of eastern North Carolina by a direct route and stay in North Carolina all of the time.

The work that has been done during the past three years since the passage of the North Carolina Drainage Law, which was begun in eastern North Carolina, has resulted in the establishment of a petition for fifty-two drainage districts. Some of the drainage work is already accomplished; in other districts the preliminary examinations have been made; and in still others the final examinations have been completed. Of these fifty-two districts, the majority of them have been petitioned for during the last year; sixteen of them are west of the city of Raleigh, or in the Piedmont section of North Carolina, on overflowed lands. We will have many of these districts represented here at this convention today and tomorrow. The reclamation of these overflowed lands has been as successful as the drainage of the swamps here in eastern North Carolina. The drainage has reclaimed land on which before the work was done, there could not be raised practically anything, and today that land sells for \$150.00 per acre.

The question has been raised during the past year in eastern North Carolina, Does drainage pay? You can answer that affirmatively for eastern North Carolina; you can also answer it in the same way for the Piedmont section. Where the drainage work has been completed and the land drained, it has paid, in every instance.

It has not been plain sailing in the organization of the drainage districts. And in connection with my report I want to bring out here some of the difficulties that have come up with the organization of some of the districts, and to emphasize the need of the State Geological and Economic Survey employing throughout the year a drainage engineer. One problem that came up was the relation of the duties of the viewers and the drainage engineer. We have one drainage district that is blocked right now because the viewers claimed that they were over the drainage engineer and that he must do his work as they wished it done. I have taken up the point with the Clerk of the Superior Court and am trying to show that the work of the viewers and the drainage engineers are entirely two separate and distinct phases of work—that the drainage engineer is not responsible to them, but to the Clerk of the Superior Court, and makes his report to the court alone.

In one district the drainage engineer was approved and appointed, the viewers appointed by the clerk; and because the clerk had not read the North Carolina Drainage Law very carefully and had not read the instruc-



tions sent to him, he failed to advertise according to law the preliminary meeting. They had the meeting, and the report of the engineer and viewers were submitted to the clerk of the court and he accepted them. Those objecting attempted to have the drainage district dismissed because the preliminary meeting and hearing had not been duly advertised according to law. That problem has been put up to the State as to whether or not it can be done. I want to state my opinion about that now, and the matter can be discussed later. I believe that the clerk can now advertise the preliminary hearing to be held on a certain date, which must be at least two weeks after the date the advertisement was posted, and that when that meeting is held, proceedings can then go on as formerly, but they can't go on and be legal until that meeting is held according to law. Simply because that first meeting was not advertised according to law does not mean that the drainage district is thereby canceled and dismissed. The engineer's report is that the lands in this district are worth draining, and the mistake made will only delay the proceedings and organization of the district.

There is another problem that has come up that we shall want to take up here. In another drainage district, after the final report had been filed with the Clerk of the Superior Court, the date of the hearing advertised, and no objection filed with him after the hearing, he declared the drainage district established. After the establishment of the district the commissioners changed the report of the drainage engineer so that the canals that had been dug are not according to the final report that was handed in and accepted by the clerk, with the result that that district is not being drained as it should be, and to get satisfactory drainage in that district the canal must be carried on farther than it is at present; in other words, the original plans must be carried out. The money raised by the bond issue has been spent, and the question now is, how to complete the work. The General Assembly of 1911 passed an amendment to the Drainage Law, that the drainage commissioners could authorize an additional issue of bonds, not to exceed one-fourth of the original bond issue, in order to complete the construction of the canals in the drainage district, if the original bond issue was not sufficient to carry out satisfactorily the drainage of the district. I believe that the commissioners of the above district have a right to complete that work and order an additional bond issue to obtain the necessary amount of money to complete it.

As I have shown, the drainage work is not entirely plain sailing; but we have been making remarkable progress in the work. We are still, however, just at the beginning of the drainage work in this State, and there is plenty of work to be done by this Association, almost as much as has been done in the past. As you know, the North Carolina Drainage Law is the result of the work of the North Carolina Drainage Association.

One other thing I wish to say is that the committee appointed by your President last year, known as the Legislative Committee, which was to take up questions in regard to the amendment of the Drainage Law of 1909, has done hard work, and the result is shown in the printed report. The Drainage Law, as amended according to the recommendations of that committee, and handed in as a bill to the General Assembly of 1911, was passed with but one change, and that related to how the \$15,000 was to be advanced. The committee recommended that it be advanced to the drainage districts out of

the General Treasury of the State, but this was amended to be advanced by the Department of Agriculture. The members of this committee were John H. Small, Washington; A. B. Lukens, Moyock; J. S. Mann, Middletown; Lawrence Brett, Wilson; Iredell Meares, Wilmington; S. S. Mann, Swan Quarter; A. B. Croom, Jr., Burgaw; R. L. Carr, Rose Hill; John Wilkinson, Belhaven; Joseph A. Brown, Chadbourn; John P. Kerr, Middletown, and Joseph Hyde Pratt, Chapel Hill, and the Association owes a debt of thanks to the men on this committee for the work they have done to make the Drainage Law a great deal more effective than it was in 1909. We do not claim that the law is yet absolutely perfect. We have had to feel our way and build it up gradually, but we hope soon to get a law that will be absolutely perfect.

I was very glad indeed to notice as I came through Beaufort County yesterday how a tile manufacturing plant had expanded its operations during the last eighteen months. Only a few years ago there was only one plant in North Carolina that was making tiling—one in Guilford County. Now there are three or four plants manufacturing tiling to be used in the drainage of farm lands. The clay is here for making drain tile, and our farmers have begun to realize the necessity of tile draining their farms if they are to get the best results in farming. Thus the demand for tiling is rapidly increasing and a new industry is being developed in Eastern North Carolina. This is another form of drainage that the Association has been and is advocating.

In connection with the Secretary's report the Treasurer's report was also read and approved, having been previously audited by the Auditing Committee, E. F. Lamb and V. T. Baggett. On motion made and seconded the Secretary's report and Treasurer's report were approved.

Before introducing the next speaker President Brown said:

I intended in my remarks to mention what Mr. Pratt spoke of in regard to the work of the Legislative Committee in drafting amendments to the drainage law. The work was left almost entirely with Mr. Pratt, and I know nearly all the work was done by him and the Hon. John H. Small. I must not take my seat without thanking the entire committee for the very faithful performance of their work.

It is with great pleasure that I introduce the next speaker. He has had much to do with the organization of this work in North Carolina, and I believe he is the most eminent authority on drainage that we have today—Mr. Elliott, Chief of the U. S. Office of Drainage Investigations, Washington, D. C.

### SOME ESSENTIAL FEATURES OF DRAINAGE IN NORTH CAROLINA

BY C. G. ELLIOTT, CHIEF OF DRAINAGE INVESTIGATIONS,  
U. S. DEPARTMENT OF AGRICULTURE.

#### PUBLIC AND PRIVATE INTEREST IN DRAINAGE.

A casual glance at the activities of the South will reveal to the business man and to the statesman the fact that increasing thought and attention are being given to the development of her lands and to perfecting improvements throughout the rural sections. The recent census shows that our population



continues to gravitate toward the towns and cities instead of to the country, as was predicted by many would be the case. There are doubtless some good sufficient reasons for this state of affairs which will appear when the situation is analyzed closely in connection with actual land conditions. The lack of profits derived from the cultivation of the soil is doubtless one of these, and with a view of showing how these may be increased, I take the liberty of pointing out some of the essentials of drainage improvements in this State which should not be overlooked by those who are interested in the development of fertile unimproved lands and the betterment of wet lands in such a manner as to make them more attractive and profitable for agriculture.

It is not strange that public interest is awakened in activities of this character, nor that business enterprises which are directly dependent upon farming interests for their prosperity look with favor upon all efforts to add to the sum total of the annual products of the soil. Transportation companies well know that the extension of cultivated lands, the settlement of productive areas, and the betterment of farming conditions in general, will augment traffic and tonnage. Companies often extend their lines in advance of development on the logical assumption that increased traffic will in time reward their enterprise, and in so doing they have given needed and substantial encouragement to those who undertake to develop agricultural sections. The business enterprises of our towns and cities are sensitive to the condition of the farming interests, bank accounts, profits, and consequent contentment of the farmer fluctuating with the production of the surrounding lands. The prosperity of the farming interests is reflected in the revenues of townships, counties, and of the State derived from general taxation, since they furnish the means for the erection of creditable buildings for public use, for the maintenance of a better class of public schools, desirable public roads, the building of monuments in memory of illustrious citizens; in short, for all those institutions in which loyal and patriotic citizens take a pardonable pride. These interests are in a sense beneficiaries from first to last of all activities in behalf of better agriculture.

On the other hand, the betterment of lands by drainage can not be successfully carried on nor can rural improvements be satisfactorily developed without an intimate association with other related business activities, for which reason a hearty welcome should be given to all lines of legitimate business which is ordinarily conducted in connection with drainage enterprises, suggesting that a common or public interest in this subject should be encouraged by all citizens irrespective of business affiliations, particularly those in eastern North Carolina. Such harmony of sentiment upon the subject and helpful coöperation of related business interests are one of the essentials of any extended movement toward the better drainage of agricultural lands.

#### PRIVATE ENTERPRISE PAYS FOR PUBLIC BENEFITS.

It should be noted that the State Drainage Law declares that drainage is a public benefit and conducive to the public health, convenience, and welfare, and it further bases the establishment of any drainage district upon its ability to bring about benefits to the public. The law then proceeds to charge individual properties with the cost of the necessary work in proportion as they may be benefited, irrespective of its value as a public improvement. While this apparent inconsistency in the law may work no hardship upon

property owners, it should be noted that the public becomes the involuntary recipient of important and salutary benefits by reason of the enterprise of individuals who may elect to join their forces in constructing large drainage works under the security guaranteed by a beneficent law. These conditions further emphasize the obligations of the public to encourage the inauguration and intelligent prosecution of drainage work.

#### ATTITUDE OF FEDERAL AND STATE GOVERNMENTS.

Under this head may very properly be considered the attitude of the Federal and State governments toward agriculture. Active and helpful interest is manifested in various ways, including assistance in the reclamation and betterment of fertile lands by drainage in response to demands by an enterprising people. Our drainage laws are the outgrowth of repeated legal contests against the application of the old common law to matters of drainage, and toward the enactment of helpful legislation under which we are now permitted to operate. The Federal Department of Agriculture has expended more than \$20,000 in the State in setting forth the possible improvements of wet lands, outlining methods of draining them, and in coöperating with the people in a variety of practical ways for promoting reclamation. As a part of this work, methods for draining more than 500,000 acres of land have been worked out, general plans for which have been placed in the hands of those who have a direct interest in perfecting the work. This, however, is but a helpful start in bringing out the latent wealth of this great State and in making it a healthful land filled with a prosperous and contented people.

#### THE EPOCH OF DRAINAGE.

There are epochs in agriculture as well as in politics, science, and discovery. One of them is now upon us, calling for the better use of lands now occupied as farms, for the reclamation of additional tracts which may be made suitable for diversified agriculture, and all of those improvements which contribute to the prosperity and comfort of a rural people. Every agricultural section has found it wise and even necessary from time to time to materially modify its practice in farming in proportion as social and industrial changes have followed the more primitive practice and customs. The land is the farmer's capital; it is his source of wealth and rightful heritage. It is certainly the part of wisdom to develop and maintain its fertility, to develop the latent strength of waste lands which lie at his door, and to embellish every corner of his personal domain with useful crops.

#### DRAINAGE BEGINS WITH THE FIELD.

The true value of drainage as an asset in agriculture is first proven on the field and on the farm. The incentive for all the larger drainage works of modern times has been furnished by the results obtained on the field and farm. It is particularly appropriate to call attention to this phase of drainage, because the loss upon many farms on account of portions of the fields which are poorly drained is rarely appreciated by the owners. The field of ten acres may contain only eight of productive land. The two acres which are wet receive the same labor and seed as the balance, but give little or no return. A good crop upon this portion would be clear profit. Why not drain it and make the entire field productive? These are seemingly small matters



which are entirely within the control of the individual planter, but they often measure the difference between profit and loss in farming.

The large yield of field crops now being gathered after a season of unusual drought further emphasizes the truth of this statement. The low lands in the cultivated fields which in ordinary years produce only a partial crop have during this year yielded their full amount. The cost of operating has been less than in years when only partial crops were grown, owing to the greater ease and convenience in cultivating and management. The striking significance and value of drainage have been shown during the present season on almost every farm. Would it not be well for every farmer to indulge in a few figures to determine the value of the additional crop he has raised on the so-called wet places in his fields this year, over and above the value of that ordinarily grown? Good artificial drainage will insure the continuance of this desirable and salutary soil condition of the farm.

#### UNITY OF PURPOSE.

It is not my purpose to here discuss so much the theory of drainage as to call attention to features which have a direct bearing upon its execution. It should be remembered that the work of thorough drainage of large areas consists of two parts, one of which may be regarded as public and is carried out under the provisions of the law, and the other private in which land owners avail themselves of their rights to public drains and perfect the work in their own way and at their own expense. Both are equally important in securing the full value of drainage in its effect upon public health and private benefit. To secure the former it is essential that landowners be fairly well united in their purpose to construct comprehensive systems. The theory of the law is that such work is wholly optional and must originate with a petition signed by a majority of the owners. A proposition should, in fact, be so meritorious as to command the assent of nearly all of those who would ultimately become a part of the corporate district. Not infrequently there exists a misapprehension on the part of many as to the real advantages that would accrue. The fact is not always appreciated that the money required for the improvement and betterment of farm lands is not merely an expenditure, but an investment which will yield a return of greater or less amount for all time. It is not a question as to whether the entire expenditure will be returned in two or three years, though that is frequently the case, but whether the outlay will procure a lasting improvement such as will yield an ample and continuous return.

#### WHY WE DRAIN.

It may be well just here to refer briefly to the salient facts as to why our lands become better by draining.

Drainage is commonly regarded as the removal of water from the surface of the ground and as being synonymous with drying the surface. This, however, is but the beginning of the process, and is not of itself drainage in the sense of the term as used in good agriculture. Let us inquire into the relation which soil, water and farm plants bear to each other. It is remarkable to what extent plants reflect the water and fertile conditions of the soil in their growth and fruitfulness. The soil must possess not only plant food, but also moisture and air, which are equally essential to the roots in the

preparation of needed nutriment. The soil is made up of solid earth particles, presenting every conceivable form and substance, of water, commonly called moisture, which surrounds each particle, and of space between the particles, which results from their irregular shape and varying size. This space portion is always occupied by either air or water, and other things being equal, its condition with respect to these elements virtually controls the plant-producing ability of the soil. Primarily, drainage has to do with soil space by regulating the amount of water, and, incidentally, the air, thereby producing the conditions most favorable for roots, and of which they promptly avail themselves. When water covers the surface these conditions are impossible, but when it has been taken off by natural or artificial channels some lands possess the property of removing the excess of water from within the soil by natural percolation and evaporation, while others will remain wet until additional means of draining are provided.

It should be remembered that while a large volume of water is required to mature a crop, the amount should be so controlled that it will be supplied regularly as needed and without rendering soil conditions unfavorable to thrifty growth in other respects. It is stated by experimenters that three hundred to five hundred pounds of water are used in producing one pound of dry vegetable matter; that thirty pounds of water pass off through a single corn plant during its period of growth, and that on summer days 1.4 pounds of water are evaporated from a square foot of leaf surface. This enormous demand of plants is supplied only by rainfall, which is taken out of the soil through the roots, and seems an almost incredible amount when we remember that an inch in depth of water on one acre weighs 101 tons, and that the annual precipitation of twenty inches to forty-eight inches is exceedingly irregular in time and variable in quantity. It is the office of drainage to remove the excess due to unusual precipitation from both surface and interior of the soil, place the latter in condition to conserve moisture during periods of drought, and make it possible for air to enter and perform the work so essential to the preparation of elements for the assimilation of plants. When this is done the many salutary effects so often observed and commented upon follow in natural order.

#### EDUCATION ESSENTIAL.

It is along these lines that the State Drainage Association, county crop demonstrations, and various State agricultural agencies should be utilized in calling attention to examples and facts that will have a bearing upon the subject. Nothing convinces the business farmer so thoroughly as demonstrated facts, and I may add none more quickly sees the fallacy of superficial reasoning when applied to farming operations with which he is familiar. A single example of successful drainage in either a field or district project will have a more convincing value than any number of flowery speeches made from the rear end of a railroad educational train.

#### COMPLETE DRAINAGE UNITS.

The value of taking up this work in a comprehensive way can not be too strongly emphasized. I refer particularly to the desirability of considering all the factors that have a bearing upon the drainage of each unit or district. The entire State divides itself into numberless watershed units. Those who



plan district work should take under consideration first the entire area which will deliver its drainage at a given point; second, the area that will be included in the district organization if it does not cover the entire watershed, and third, the various farms within the district which it should be remembered will be the principal beneficiaries of the entire work. In the case of the improvement of small streams and their overflowed valleys, the problem as to the amount of run-off from adjoining higher lands is always one demanding careful examination.

I am familiar with some drainage improvements (so-called) in other States which, though entailing a large expense, have accomplished no good, but on the contrary injury to property because the channels which were intended to afford relief were wholly inadequate for the duty required of them. It is needless to say that the effect was discouraging in the extreme. I am also familiar with a territory where the main ditches are now being enlarged the second time in the attempt to secure effective drainage, and still another instance where preparations are now under way for enlarging an important channel before the original contract for its construction is completed. I may be called an obstructionist because I mention attempts to drain which have failed. Much as I regret to say it, great numbers of such instances could be pointed out. Very good and sufficient reasons for such failures, however, can be given.

I cite these examples only to show that errors of this nature have been frequently made, and to urge that they should not knowingly be duplicated in this State. There are certain facts of rainfall and run-off, and the relation which topography, soil, and channels should bear to them in the control of waters for the good of agricultural lands that should not be disregarded. The constant effort of the Department with which I am connected has been to guard against the repetition of such errors in this and other States, and with that end in view it has collected during the past two years much accurate data upon the subject which will be submitted for publishing as soon as the copy can be prepared.

#### THOROUGHNESS ESSENTIAL.

Thoroughness, another essential element in successful drainage, is equally important in both public and private activities. It occurs to me that we are now in a position to give this phase of the subject the consideration it merits. With reference to large and level districts, we could in many instances introduce a larger number of main ditches with profit. While the law provides for the construction of auxiliary ditches for the accommodation of lands lying distant from a public ditch, it would be more economical and satisfactory in the end to include such ditches in the original plan. Aside from general and health benefits, the ultimate object of all drainage activity is to reach the field and farm.

In general, district ditches should be from seven to eight feet deep, even where such depth reaches a sandy material. The more thorough drainage given to outlying lands is a sufficient reason for this, and often marks the difference between satisfactory and poor drainage. It may be urged that ditches with sandy bottoms will soon partially fill with sediment. This is sometimes the case, but not so frequently true as is generally believed. Ditches with a broad bottom assume a semicircular shape and, owing to their

depth, have a velocity of flow at the bottom which aids greatly in keeping them clear. It may not be out of place to mention the fact that ditches must be cleaned from time to time, whether they be shallow or deep; but the deep ones will more nearly maintain themselves for the reasons before named. The trend of improved drainage methods is towards the construction of a greater number of ditches in level districts, all of them of reasonable depth in distinction from shallow drains, and of ample capacity. I can safely predict that there will soon be a demand for high-class culture on these drained lands and for thorough drainage, which is a necessary attendant. We should not be called upon to revise our drains before we fairly begin. A little foresight in this regard will be of great value.

#### MODERN EQUIPMENT.

The facilities for reclaiming lands have been so perfected that work which was impracticable a few years ago is now feasible and profitable. The steam excavator with the aid of dynamite lifts the stumps easily aside and plows a canal through the wooded swamp at a cost which is far less, notwithstanding the present high price of labor, than that at which ditches of similar size were excavated years ago in the prairie districts. When the land is drained the donkey engine with cable pulls the shattered stumps and other useless wood into stacks for burning, leaving the field ready for stuck-corn and later the plow. One or two crops at most yield sufficient to defray the entire cost, leaving a farm of new land ready to repeat the crop each succeeding year.

As to the first cost, it should be understood that land can not be developed in six months or a year, like a factory or an electric road. The proceedings prescribed by the law must be followed absolutely, the work should be carefully planned and well executed, and the interests of all landowners should be carefully guarded. For these reasons, two and sometimes three years elapse, where districts of medium size are worked out, before any returns are obtained from the land. If it is fertile, and the plans under which the drainage is accomplished are sound, no fears need be entertained that the operation will not pay out with abundant interest on the amount invested.

#### A PRACTICAL PROPOSITION.

Here is a practical proposition. The swamp lands, overflowed bottoms, low tidal lands, as well as cultivated wet lands, are in private ownership. The cut-over lands are yielding no revenue. Their reclamation and betterment will be a public improvement and to that extent the public should manifest an interest. In fact, the very possibility of their drainage is an asset to the owners. Under present prices of improved lands and of farm-products, and the proximity of North Carolina lands to the seaboard markets, there are no more promising fields for business enterprise than the reclamation of the wet lands of the State. The returns are not so quick nor so large as they are from some so-called legitimate operations in the business world. Yet the owner of such lands need not look for a safer field for the employment of his capital nor for a more satisfactory line of activity than that of draining and preparing them for remunerative crops.

#### GROWTH GRADUAL AND CONTINUOUS.

Drainage for agriculture is most emphatically a development. It does not advance by leaps and bounds, but grows gradually until it becomes a well





recognized and essential part of agricultural operations. Tenants as well as owners should have a voice in this improvement, for both are equally concerned in the betterment of lands. When they are put in uniformly good condition they attract the most enterprising and skillful tenants, who take pride in building up the institutions of the community in which they live. Every movement in the interest of healthful living, bountiful production, and the amenities incident to a happy and contented life may appropriately originate with the intelligent farmer of modern times. There are young men here today who will live to see every swamp in the State thoroughly drained, the waste land on every farm producing a bountiful crop every year, attractive and convenient residences, excellent public roads, and all needed railway transportation. Other places less favored in point of natural advantages have passed through all these stages and now enjoy the fruits of well directed labor and commendable enterprise. The way is open for North Carolina.

PRESIDENT BROWN: I think a great debt of gratitude is due Mr. Elliott and his corps of assistants for the splendid work they have done in the past three years. The Agricultural Department has been very generous in their assistance to North Carolina, and they began to help us at a time when we most needed assistance. I have had occasion to notice their work and I have never known a band of harder workers and men who entered into the spirit of their work more earnestly and zealously than those men in my section. We appreciate the assistance rendered and thank Mr. Elliott for it and also for his very valuable paper just read.

Mr. E. F. Lamb, Secretary of the Chamber of Commerce, made a motion that the address delivered by Mr. Elliott be referred to a committee, with a request that immediately upon the convening of the afternoon session they present certain points in it for discussion before the convention. The motion was carried and President Brown appointed on this committee Messrs. Pratt, Lukens, and Privott.

The following question was then asked of Mr. Elliott by one of the delegates: "I would like to know what the Department has to say with reference to cement tiles—whether they have any preference to clay or cement?"

Mr. Elliott said: "The cement tile has been used very successfully in Iowa and in other States. The fact seems to be brought out that cement is favored, but it is pointed out that they have been poorly made; that the manufacturing of them has not been fully understood and they were badly made at first. I think at present cement tile properly made, with a mixture of one part of cement and three parts of sand, is just as good as, but no better than the clay tile. It has been pointed out that cement tile is more porous; that water will pass through more freely than it would the clay tile. As to the comparative value, I

think it is merely a matter of cost when they are well made and that one is just as good as the other—simply a matter of durability. We are safe at present in using good clay tiling. We may be just as safe in using cement tiling if we know that they are well made. The difficulty seems to be in determining when these tile are properly made. I just want to say that the matter is under discussion and that there are advocates of both kinds. It has been pointed out in a good many instances that they have not been satisfactory. I think it is because they have not gotten them all uniformly and well made.”

Just before the close of the morning session the President appointed the following committees:

*Committee on Nominations and Next Meeting Place.*—W. S. Pharr, chairman; John A. Wilkinson, George W. Best, P. B. Beard, A. B. Lukens, Lawrence Brett, C. W. Mengel, J. B. Sellers, L. S. Blades, and Joseph Hyde Pratt.

*Committee on Resolutions.*—W. S. Privott, chairman; John H. Small, C. G. Ferebee, J. F. Foster, Walter Cahoon, B. F. Keith, V. T. Baggett, and Joseph Hyde Pratt.

A cordial invitation was extended to the delegates by Elizabeth City to attend a banquet Wednesday night, given in honor of the delegates attending the convention.

#### AFTERNOON SESSION—WEDNESDAY, NOVEMBER 15, 1911.

The afternoon session was opened at 2:30 o'clock, with President Brown in the chair. The first business was the report of the committee on the Elliott paper, which reported that four points were especially emphasized in the paper and were very pertinent to the drainage work in North Carolina, *i. e.*:

1. The drainage of the swamp lands is a *public benefit*, but is paid for by private capital, and why should not the State pay something, at least enough to cover the cost of making the surveys of the drainage districts?

2. There is still need of education as regards the need and value of drainage.

3. The work of organizing and surveying a drainage district must be thorough and be done exactly according to law. This is absolutely essential to the success of the districts and the sale of the bonds.

4. Drainage bonds are good investments.

The report of this committee started a very interesting and enthusiastic discussion of these four phases of the drainage work, the following



taking part in the discussion: Joseph A. Brown, Thomas N. White, Franklin, Virginia; John A. Wilkinson, Joseph Hyde Pratt, Lawrence Brett, B. F. Keith, John H. Small, and C. E. Sims. All were of the opinion that the State should assist in the drainage work to a greater extent than she is at the present time and that the State should make an appropriation sufficient to enable the North Carolina Geological and Economic Survey to employ a drainage engineer, who would devote all his time to the drainage work.

#### REPORTS OF REPRESENTATIVES OF DRAINAGE DISTRICTS.

A considerable part of the afternoon session was taken up with the reports from representatives of drainage districts. A call of the districts was made by the Secretary and the following responded:

"Back and Jacob Swamp Drainage District of Robeson County," by J. B. Sellers.

"Bear Swamp Drainage District of Chowan County," by W. S. Privott.

"Broad Creek Drainage District of Beaufort County."

"Camden Run Drainage District of Camden and Currituck Counties."

"Chadbourn Drainage District of Columbus County," by Joseph A. Brown.

"Conaby Creek Drainage District of Beaufort County," by Lawrence Brett.

"Creswell Drainage District of Washington County," by H. A. Litchfield.

"Deep Creek Drainage District of Edgecombe and Halifax Counties," by Lawrence Brett.

"Dover Drainage District of Craven County," by Lawrence Brett.

"Fair Vista Drainage District No. 1, of Wayne County," by George M. March.

"Flea Hill Drainage District of Cumberland County," by C. W. Mengel.

"Lake Phelps Drainage District of Washington and Tyrrell Counties."

"Little Contentnea Creek Drainage District of Wilson County," by Lawrence Brett.

"Little Coharie Drainage District of Sampson County," by V. T. Baggett.

"Lyon Swamp Drainage District of Pender and Bladen Counties," by B. F. Keith.

"Mattamuskeet Lake Drainage District of Hyde County," by Lawrence Brett.

"Mecklenburg Drainage District No. 1, of Mecklenburg County," by W. S. Pharr.

"Moyock Drainage District No. 1, of Currituck County," by A. B. Lukens.

"Muddy Creek Drainage District of Duplin County," by J. R. Quinn.

"Pungo Drainage District of Beaufort County," by J. H. Carter.

"Third Creek Drainage District of Rowan County," by P. B. Beard.

"Toisnot Creek Drainage District of Wilson County," by Lawrence Brett.

"Wayne County Drainage District No. 1, of Wayne County," by Lawrence Brett.

These reports were full of interesting information, and illustrated extremely well the widespread interest that there is in drainage in North Carolina.

Mr. B. L. Bugg, of the Norfolk Southern Railroad, made a short talk, telling of the great interest that the railroad which he represented has in the drainage of the swamp lands of eastern North Carolina, and that they would do everything they could to further the work.

The Secretary then read a telegram from Mr. E. T. Lamb, President of the Norfolk Southern Railroad:

DR. JOS. HYDE PRATT, *Elizabeth City, N. C.*: CHICAGO, ILL., Nov. 15, 1911.

Very much regret that owing to engagement here it will not be possible for me to be present at Elizabeth City today. Hope the convention will be a success in every respect.

E. T. LAMB.

A letter was read from Mr. O. L. Clark, of Clarkton, North Carolina, under date of November 14, 1911, as follows:

I find at the last moment that it will be impossible for me to be with you in Elizabeth City, to discharge the duty assigned me, viz., make report on the work in the White Oak Drainage District of Bladen County. You will find enclosed a list of answers as returned to me from one of the principal land-owners in the district, and it tells in a very condensed form what I should say were I with you.

Judging from the answers to my inquiries, they are all drainage enthusiasts over here now, and no one blames them, because with an expenditure of approximately \$20,000.00 on \$6,000.00 worth of swamp land, they now own the most fertile of fertile lands, and refuse \$100.00 per acre. Considering the fact that not less than fifty bushels of corn was gathered from a single acre under cultivation this year, it looks as though this valuation is a minimum one, and makes Standard Oil look like THIRTY CENTS! By means of drainage these men consider their property increased to \$200,000.00—that is, after it's all cleared, the cost of which is included in the \$20,000.00.

Regretting very much that I will not be with you, and wishing for you a most successful convention, I am,

Very sincerely,

OSCAR L. CLARK.



## QUESTIONS.

## ANSWERS.

- |  |  |
|--|--|
| (1) Name of district?  | White Oak Swamp Drainage Com-<br>pany.     |
| (2) Number acres in district?  | 2,000 acres.                               |
| (3) Promoter of district?  | C. W. Lyon.                                |
| (4) Principal landowners?  | C. W. Lyon, Lee Smith, and W. J.<br>Keith. |
| (5) Miles of ditch?  | Six miles.                                 |
| (6) Size of ditch?   | 7 x 18 feet.                               |
| (7) Value of land before draining?   | Three dollars per acre (\$3.00).           |
| (8) Value of land after draining?  | \$100.00 per acre.                         |
| (9) Cost of clearing?  | Six dollars per acre (\$6.00).             |
| (10) Cost per acre in whole district,<br>including cost of dredge?   | Twenty-five cents to \$5.00 per acre.      |
| (11) Entire cost of drainage district?   | \$8,000.00.                                |
| (12) Cost of dam and length?   | \$3,000.00. Length, one mile.              |
| (13) How much corn will cleared land<br>yield per average acre?  | Fifty to one hundred bushels per<br>acre.  |
| (14) Cost of dredge?   | \$4,500.00.                                |
| (15) What will you take for dredge?  | \$2,250.00.                                |
| (16) After dredge is sold, at price<br>asked, what will the cost per<br>acre then be?  | Twelve cents to \$2.50.                    |
| (17) Did you contract the work by<br>yard, or do the work with day<br>labor?   | Day labor.                                 |
| (18) What do you think of your in-<br>vestment?  | Best I ever made.                          |
| (19) After your experience with the<br>district, would you advise<br>others, as a business invest-<br>ment, to form drainage districts<br>and clear swamp lands? | I surely would.                            |

C. W. LYON, *President*  
White Oak Drainage District.

Invitations were received from the following cities for the next convention of the Association:

Raleigh, North Carolina—invitation extended by the Chamber of Commerce. Wilson, North Carolina—invitation extended by the mayor and the Chamber of Commerce. Salisbury, North Carolina—invitation extended by the chairman of the Board of County Commissioners. Charlotte, North Carolina—invitation extended by the Greater Charlotte Club.

## EVENING SESSION—WEDNESDAY, NOVEMBER 15, 1911.

A most delightful feature of the convention was the banquet given Wednesday night in the auditorium of the Elks Club, complimentary to the visitors. The splendid success of the banquet was due to the local entertainment committee, composed of Louis Selig, chairman; W. J. Wordley, C. O. Robinson, M. Owens, and O. F. Gilbert.

The banquet was called to order by Mr. W. J. Wordley, President of the Chamber of Commerce, who asked the Rev. C. F. Smith to ask the blessing. He then in a very graceful and appropriate speech turned the banquet over to the Association and asked President Joseph A. Brown to act as a toastmaster.

Not only were the very appetizing viands most thoroughly enjoyed by the guests, but also the talks that President Brown persuaded a number of the guests to make. Those responding were: J. K. Wilson, Elizabeth City; Dr. J. H. White, Elizabeth City; John Wilkinson, Belhaven; Walter Sharp, Norfolk, Virginia; T. J. Markham, Elizabeth City; P. B. Beard, Salisbury; Rev. C. F. Smith, Elizabeth City; A. B. Lukens, Moyock; B. L. Bugg, Norfolk, Virginia; B. F. Keith, Wilmington; C. R. Van de Carr, New York; Lawrence Brett, Wilson; Dr. J. R. Alexander, Charlotte; Joseph Hyde Pratt, and John H. Small.

## MORNING SESSION—THURSDAY, NOVEMBER 16, 1911.

The closing session of the Convention was called to order by President Brown at 10 o'clock on Thursday morning, and prayer was offered by Rev. C. F. Smith, rector, Christ Church. The President then introduced Hon. John H. Small, Congressman from the First Congressional District. He referred to him as one of the staunchest friends of drainage in the country, and one who has worked incessantly for the drainage of North Carolina's swamp and overflowed lands.

## ADDRESS BY HON. JOHN H. SMALL

MR. PRESIDENT, GENTLEMEN:—I always feel, when I come to the consideration and the discussion of any one of these economical movements which are practical both in the origin of plans upon which their success must be propagated, and which require practical knowledge for their execution, a degree of embarrassment. To stand before men of practical affairs who have studied the problem and to endeavor to bring something for their enlightenment and instruction ought really to be embarrassing to one who has not engaged actually in the solution of such practical problems.

This particular era in the history of the entire country, but particularly of the South, is differentiated from any other period in our past history in that there are more men and more women who are today giving their atten-



tion and their time as a contribution to the solution of many of these practical problems which make for our material welfare than has ever been the case in our past history. We have had here in North Carolina during this past decade great and wonderful propaganda in the cause of such education. Just now we are in the midst of a movement of almost equal activity for the improvement of our public highways, and within the last few years we have witnessed prodigious energy and activity in an endeavor to solve that problem which lies at the base of successful agriculture, the problem of drainage. It is unnecessary to talk to practical men about the relationship of drainage to plant growth and successful farm life. My reading and my observation lead me to the expression that if all the other given conditions to successful agriculture are present, and there is too much water upon the lands, and too near the surface, the efforts of the farmer, no matter how intelligently directed, must be of necessity a failure. It does not require any illustration to demonstrate the truth of that proposition. How often have we had farmers, the possessors and tillers of fertile lands, tell us during April and May and sometimes even as late as June, "We have good crops," and after July and August have passed, in mournful tones that their crops have been "drowned out," meaning nothing more nor less than that in the meantime excessive rains had fallen upon the lands and that their facilities for the moving of the water from the lands were not sufficient to take it off with the necessary rapidity, thereby impairing and sometimes actually destroying the plant life.

It is estimated that among the cultivated lands alone in North Carolina, some of these lands having been cultivated for a hundred years, that this condition exists upon an area of about six million acres. Agriculture upon such lands is an unsatisfactory and of necessity an unprofitable occupation. What would be thought by the individual who was sought to come into a town and engage in business, in merchandise for instance, if he were told, "You can only be successful, regardless of your best efforts, in one of each four years; out of that period for two years you will be only fairly successful, and about once in four years you may look for a total failure"? What would be thought if we should invite to come into the community a gentleman of capital to engage in some manufacturing enterprise and to employ labor to carry on his work, if we should say to him, "No matter how much intelligence you may exercise, no matter how much technical skill you may apply, no matter how abundant your capital, we must tell you that you can only succeed about once in every four years; you will only have moderate success in two years of the four, and about one in four years you will absolutely make no profit whatever"? Would the man move into your town under such circumstances? Would the man with capital and technical skill come into the community to establish a manufacturing enterprise? The question answers itself, and yet there are hundreds, aye, thousands of farmers in North Carolina who are attempting to cultivate these six million acres of fertile lands under such unsatisfactory and unprofitable conditions.

Besides that, we have in the State, particularly in the coastal plain, an aggregate area of 2,800,000 acres of swamp lands. Of this total it is estimated that at least one million acres are susceptible of drainage. These are the most fertile portions of our lands, whether located in the coastal plain or in the valleys of the Piedmont section. Upon them has been cast by the

swollen streams the very cream of the lands above and around them for centuries. They are fertile because they contain all the constituents which are necessary for the development of plant growth.

So that we have two conditions confronting us; this large area of unreclaimed land, the most valuable in the State, and these millions of acres which can not be profitably cultivated because they are not sufficiently drained. Could there possibly be a problem more vitally affecting the welfare of our people than the reclamation of these lands, and the proper drainage of those already cultivated? The furtherance of the movement for the encouragement of these two sole purposes is the object of the North Carolina Drainage Association. It merits the best efforts of the public spirited and progressive men everywhere. This condition not only applies to North Carolina; it is equally true, though not in the same degree, of our sister State of Virginia. It is just as true of South Carolina and Georgia and other Southern States. It is also true of the great States of the Mississippi Valley. If the aggregate of unreclaimed land, possessing all the elements of fertility, could be put into one contiguous area, it would make at least four or five States of the size of North Carolina and Virginia.

When this Association was organized in 1908 these were the conditions which confronted us, and their solution we set out to solve. One of the first acts of this Association was to formulate a modern drainage law. And I think, by reason of some comments which I have heard from gentlemen since I came over here yesterday, that it might be profitable to refer briefly to some of the essential features of such a law. This Association, through a committee appointed by it, formulated a law which was substantially enacted in 1909, and was amended by the last Legislature of 1911. While there are details of that law which could well be modified or changed, yet its prominent and salient features are comparatively simple and effective. In the first place, before going into its provisions, it is our purpose to call attention to what we understand was emphasized on yesterday by Mr. Elliot, the Chief of the Office of Drainage Investigations of the United States Department of Agriculture (I regret that I was not so fortunate as to hear his address), and that is the public benefits connected with the drainage of our land. Those public benefits may be briefly summarized under two heads: the public health, the necessity of drainage in the construction of good roads, and, generally, the public convenience and the welfare of all the people.

So far as the public health is concerned, undrained lands have been a menace to healthful conditions since the world began. One of the gentlemen here yesterday referred to an historical fact, *i. e.*, that the greatest factor in the destruction of Rome was the prevalence of malaria. And we now know that malaria may be traced to that same kind of mosquito pervading this undrained district, which produces chills and fevers, and impairs individual health generally. It is not a problem confined to Eastern North Carolina and Virginia alone, because we heard on yesterday one or more of these gentlemen who live up as far as Mecklenburg speak of malaria and unhealthful conditions in the undrained valleys of his section. I was greatly surprised in going into a drug store in Asheville a few years ago and making inquiries as to what kind of drugs they sold, to be told that they sold as much quinine as one drug store in the town of Washington sells, or,



I doubt not, as much as one in Elizabeth City. Of course, quinine is not prescribed altogether for malaria, but a sufficient proportion as to indicate that malaria exists even in the mountain metropolis and the surrounding vicinity. Wherever the lands are undrained, there we find malaria and a tendency toward other diseases. Medical men in their recent investigations have discovered that malaria, typhoid fever, and other forms of fever which it is not necessary to mention, may be classed as preventable diseases, and without going into details, we, by the drainage of these lands, either in this coastal plain or in the Piedmont section, may make them just as healthful and attractive as any area in the Appalachian Mountains. We can take any of these sections here in eastern North Carolina which have formerly been avoided by the home seeker and, by compliance with two other simple conditions, going down and getting pure water and then screening our houses to keep out such of the insects as we can not destroy, produce such conditions of health as will make our section of the State as attractive and healthful as any other section. What a great public benefit may be subversed if we can banish malaria along the coastal plain from New Jersey to Florida! My wife got a letter from a lady up in \_\_\_\_\_ County, saying she could not come to visit her until December, because she was afraid she would get sick; she was afraid of the malaria down here. It is not nearly as bad as it is painted, but it is bad enough. And we owe it to ourselves as progressive men who have the courage and the initiative to tackle this difficult proposition, to solve this problem in the interest of the health of our people and the reputation and prosperity of our State.

We can not have good roads without drainage. I hesitate to speak in the presence of the experts in this audience, but I understand that you may use the best materials, the materials specified by the best engineers, to make macadam roads, and if they are built upon undrained soil, in a year or two they begin to decay and in a little time will be so impaired as again to become bad roads. You can't build the sand-clay road so popular in the South now upon undrained land. In short, you can't build any sort of good permanent road on undrained soil. Therefore, the public benefit also results in preparing the way for the successful fruition of this activity, at the present time engrossing the attention of the people, the building of good highways. It is for the general convenience of all the people.

Of course, if all the landowners in a given area were unanimous in wanting drainage, you would not need any law, because they would then simply send out a commissioner to apportion the benefits accruing to the several landowners by reason of the drainage, and the whole purpose could be accomplished. But unity in any public question will not be secured until the millenium comes, and the millenium is not quite here yet. It is impossible to secure unity to any proposition, no matter how meritorious, and, therefore, in any given area, whether in one hundred, or five hundred, or a thousand acres, there will be a few, one or more, who, in spite of reason, will be obdurate and will not join with the majority. It is one of the basic provisions of the Constitution of the United States, and of the constitution of any State, that you can not take property from another, and you can not assess a tax upon another, except for a public purpose. If we are going to establish a drainage district we must assess every tract of land in order to raise the common fund necessary to accomplish the drainage. And, based upon these

public purposes, based upon these public benefits, the law says that we have the power and the right to compel any one of the landowners in the district to pay the proper cost, because a public use and benefit will be subserved.

Speaking about this disposition on the part of some men never to agree: You know in the towns, under the law, the municipality has the right to pave a sidewalk and make the abutting landowner pay the entire expense. They have the right, under legislative grant, to pave streets and assess a certain proportion of that pavement to the abutting landowners. Right here in Elizabeth City you have built some paving under that power. I know a man who lives in another town, who had a vacant lot which he had owned for thirty years (he was a man fifty or sixty years old); it was in the midst of the town; that is to say, there were residences on one side and business houses on the other. He was one of those men who would not improve nor sell, and I expressed my opinion of that kind of man yesterday. In this town they paved the sidewalks all along that street, and while he objected to it, saying, "I don't want nor need it," they made him pay for it, and after a while he cheerfully paid for it. That man owned a tract of land in a certain section where they were about to establish a drainage district. He would not consent to join as a petitioner; they made him a defendant, and he has been contesting every inch of ground, and he is putting it upon the ground that he owns about two hundred acres of land and does not want it drained, that he is not ready to improve it, that he ought not to contribute to the drainage because he does not want to drain his own land, and, therefore, ought not to be compelled to drain his own land and pay the common expense of draining all. That is the kind of man who has stood as an obstacle to progress in every section from all time. I know another man who owns a thousand acres of fine swamp lands. To my certain knowledge, he has been going before the Board of County Commissioners every year for eighteen years, contending that his tax was too high on those lands and that they ought to be lowered, the tax being one dollar per acre, and for years only twenty-five cents. They want to form a drainage district there. It is necessary to include his lands, because they lie almost in the center of the proposed district, and he is contesting the right and power of the public to assess his lands and make him pay and contribute to the common burden and benefit.

Isn't it an appropriate inquiry—who contributes most to the upbuilding of the community and the State, the humble laborer who goes to his work at seven o'clock in the morning and works until six or seven in the evening, and gets his wage of seventy-five cents or a dollar and a half per day, and goes to his home at night with a consciousness of having done his honest day's work and given his earnings for the support of his family; or that man whom I have described? Yet we have been too often, here in the South, looking down upon this man because he is poor, and looking up to the other man because he owns thousands of acres of land. No man lives alone. Each of us is our brother's keeper; each of us has a public service to perform, and the man who has lived during his entire life encrusted in his own little selfish shell, having no regard for the men and women of his community and only for his personal affairs, has been the handicap on the progress of many, many, many communities. I would like to see such a public spirit cultivated in ever community in North Carolina as would point out



that man as separate and apart from the others, and if he would worship the god of selfishness instead of at the shrine of civic duty, let him be separated unto himself, and let it be understood that he is not one of the common men, looking to the common benefit.

But Dr. Pratt limited me as to time, and I am diverting a little. I am going to devote the balance of my time to just a few words about this law, which I would like briefly to summarize.

The majority of the landowners, or those owning three-fifths of the area of the lands to be drained, must file a petition with the Clerk of the Superior Court of the county or counties in which the lands lie, setting forth the facts, as required by the law; that is to say, that they wish to drain these lands, that it will be for the public benefit, and so on. Then, summons is served upon all the other landowners in the proposed district who would not join in the petition. At the end of a certain number of days, after the service of the summons, the clerk hears the petition, and nothing appearing to the contrary, it is his duty to grant the petition, and to order viewers appointed consisting of one drainage engineer and two freeholders in the proposed drainage district. The board of three viewers are instructed to go upon the lands, to ascertain if there are any lands in the district which ought not to be in the district; if so, exclude them; if there are any lands which ought to be in and are not, and if so, to include them; whether it is susceptible of drainage and whether or not the public benefit will accrue. Then they make their report to the Clerk of the Superior Court. The clerk either confirms or modifies or rejects their report; and, by the way, any landowner has the right of appeal from the judgment of the Clerk of the Superior Court, either that he is included and ought not to be included, or that he is not included and ought to be, or any other part of the report affecting any substantial right of his property. Now, after that report is confirmed, and if it is not appealed from, the clerk of the court directs this board of viewers to go upon the lands again, to survey out the boundary lines of the landowners, to go on each tract of land, and to classify it as to benefits; the lands most benefited Class A, the next Class B, the next Class C, and so on. The board of viewers, through the engineer, are required to make the plans for the drainage of those lands and then to estimate the cost of same. The duties of the Board of Commissioners at this time are exceedingly important. After they are completed they again file a report with the Clerk of the Superior Court. Notice is given to landowners to come in and view the report and make objections if they have any. At the end of that time the clerk hears it and considers any objections. He overrules objections or approves them, as the case may be, and after the whole matter is considered he approves it, entirely or in modified form.

In the meantime, objecting landowners, if dissatisfied with the clerk's decision, may appeal to the Superior Court in term time and have the judge pass upon the law and a jury upon the facts. Or he can take it up to the Supreme Court, the point being that the rights of each landowner are subserved. When approved, the landowners can appoint three commissioners, and upon their election, the drainage district at once becomes a corporation, these three commissioners become directors of that corporation, and the district is given a name, as Bear Swamp District, or Moyock District. This drainage district has all the powers of any other corporation. The commis-

sioners then prepare to issue bonds, and in the sale of their bonds they sometimes meet with difficulties. Not repeating what I said yesterday, I will just emphasize the statement, that it is of importance that the attorney for the drainage district shall carefully observe all the provisions of the Drainage Law, because if he does not do so, the men or the company which propose to purchase the bonds, employing a lawyer to look into them, will be sure to find flaws in the proceedings and will decline to take the bonds.

The commissioners also advertise for bidders to construct the drainage works in accordance with the plans of the engineer. They enter into a contract with the lowest bidder—the lowest, if there is no other reason why they should reject his bid. The contractor enters into a bond for the faithful performance of his work, and then they appoint a superintendent of construction to see that it is carried out. From the proceeds of the bonds, the contractor is paid from time to time for his work, based upon his monthly reports, but ten per cent is withheld to the end, as a guaranty.

Now, in my hurry, I am omitting several things which I had intended to present. In the brief time now remaining I would like to claim your attention to discuss some of the obstacles toward the successful formation of the drainage district. This movement differs from most of the economical activities which are for the material upbuilding of our section in that it can only be accomplished by the coöperation of the landowners. Many of these modern methods which have been approved by science and experience, and which make for the welfare of the public, may be put into practice by the individual alone, but some of them can only be effected by coöperation, and this is one of them.

Those of you who have attempted to form a drainage district have experienced some of the difficulties arising from this condition. One of the difficulties comes from the inherent disinclination of our people to have bonds issued secured against their landed property. Many of our citizens are absolutely obdurate upon this point. It is difficult to convince them that there is any virtue in a bond issue of any kind. And there is a reason for this, in my opinion. I don't know how our friends have found it in Virginia, but from my earliest recollections as a boy the principal argument of both political parties in every campaign has been reduction of taxes, and the political party which could successfully claim that they had reduced taxes, thought they had reached the very acme of perfection in the administration of government. There never was a greater economical error than that. Just as individuals can accomplish nothing in the successful solution of their problems without the expenditure of capital and labor, just so the same condition applies to communities and to States. Low taxes are not the panacea for bad government. Good government consists in the disposition to levy all the taxes which are necessary for the accomplishment of purposes which will benefit all the people. And any tax which in its expenditure will bring benefits to the people, will result in their uplift and will brighten and make life more worth the living, provided it is honestly levied, collected and expended, is best. Because of those doctrines which have been preached to our people for all these generations, we have become prejudiced against taxes and bonds for any purpose. You will find hundreds, aye, thousands of citizens in North Carolina who, if the question of issuing bonds by the State for any purpose is mooted, without the slightest inquiry, will at



once announce their opposition to it. They don't care what purpose it is for, the mere fact that bonds are to be issued is sufficient, since this prejudice has been created in the minds of our landowners. When they understand that bonds are to be issued their opposition is at once aroused. That we must overcome by going out among our people and teaching the proper doctrine, that the issuing of bonds makes possible the accomplishment of the drainage of their lands and that drainage can be accomplished in no other way, and that under these conditions the issuing of bonds is a wise act.

Another difficulty is the indisposition of our people to coöperate. There is not one of us who has not met that difficulty face to face. You meet it in your church, you meet it in any public enterprise, whether the question be to levy a local tax for a public school or build roads in your county, wherever the movement is of such nature as can only be accomplished by working in harness, we meet everywhere the same ultra conservatism on the part of our people. I was very much impressed some years ago upon reading a memorial address by Secretary Whitney, the then Secretary of the Navy, after the death of Mr. Russell, of Massachusetts, who died after making a remarkable record. He paid him this eulogy, that he was a man who by natural endowment and training was capable of leading any movement, and yet at the same time he had that other equally valuable qualification of the citizen, of being able to work in harness with his fellow-citizens. And it is a valuable civic asset for any man to be willing by self-abnegation and forgetting for the moment all pride, to touch elbows with his fellows, sacrifice his personal feelings upon some phase of the subject, and join forces and work together for the common benefit. Occasionally, but not always, it is ignorance that prevents men uniting and working together for the public good. This, I say, is not always true, because we find this same tendency among men who know better, whose training and experience has taught them better. It is rather due to a lack of education as to their relationship to the community in which they live. Those are the two chief difficulties which I have observed in North Carolina in the formation of these drainage districts.

And now, to hurry along, and not referring to any other phases of the subject (and there are some other difficulties), how may the difficulties be overcome? I know of but one remedy, agitation, publicity and education. Until we organize some active propaganda and are prepared to send out among the people men who are familiar with the difficulties of this proposition to talk to the people face to face in their own communities, we will not have reached them and have solved this problem successfully. Here we are, a few of us, gathered together, and I take it we may indulge in self-congratulation to say that at least in part we have consecrated ourselves to the public service in this problem of drainage in North Carolina and in Virginia. But we are only bagatelles, no matter how thoroughly we may have been converted, and have consecrated ourselves to the solution of this problem, because it doesn't count unless we can carry the convictions which we have acquired out to the people who own the land and who must be convinced and whose attitude must be changed if we are going successfully to drain these lands which will make such a valuable asset to our community and to our State. I hope that between now and next year, when we meet in Raleigh, some committee of this Association shall adopt some means by which we can

organize a corps of speakers and send them abroad in the State. We have learned that in prosecuting this movement for the public education we must send men in all sections to talk to the people. Our State Association for the Promotion of Public Roads has learned that lesson to an extent, and we hear of meetings here and there throughout the State. But where are the men who will go out and talk drainage and tell of its great value to the people? Why, gentlemen, it is sad to see men, who will stand out against their own interests and for such reasons as seem to actuate them. They had an election in Gaston County on the question of the establishment of a farm life school, a school which was intended for the benefit of farmer boys, and yet it was defeated, and defeated by the farmers' vote. I doubt not but that if a movement was instituted here to establish a farm life school in this county, that they would have no trouble in getting the vote here in Elizabeth City, where the question was agitated and talked about and given publicity, but the probability is that if it was defeated it would be defeated by the vote of the farmers of Pasquotank County. There are men here in Pasquotank County whom I know personally, men in every section of North Carolina, who are living upon lands unsatisfactory as to production, and which could be made profitable by drainage, who, if a drainage district was started in their section would hold back upon the ground that they did not want to issue bonds, and on various other untenable grounds. Sometimes they can be converted, but not always.

Without intending the slightest egotism, I wish to say that I am willing to be one of the band of volunteers to go about and present to the people this problem of drainage, the necessity of coöperation, explaining away the alleged difficulties which exist in their minds, because in that largely lies the success of this movement.

In conclusion, while there are only a few of us gathered here today, let us consecrate ourselves anew to this movement in which is involved in such large degree the increased prosperity of our section. We are congratulating ourselves just now in having home seekers come down and look into our lands. The only lands they look at and the only ones they find attractive are drained lands, and in addition to that they want to know that they are going to have good public schools and good roads, the triplicate hand-maidens of public service. Let us consecrate ourselves anew, and let us adopt some plan, through the aid of our officers which we are going to elect, which will next year have every county in the State of North Carolina represented in Raleigh, a bringing together of a thousand, aye, five thousand men, who will give this movement such additional impetus as will keep it going and help us in the solution of this great problem. It has been waiting for a hundred years. Public spirit, civic enterprise, devotion to community duty—these are the factors in its solution, and the only ones.

After a short discussion of Mr. Small's paper, the President called for the report of the Committee on Resolutions. This committee's report was unanimously adopted and was as follows:



### REPORT OF COMMITTEE ON RESOLUTIONS

The North Carolina Drainage Association, in its fourth annual convention, may indulge in congratulations upon the results which have been accomplished since the initial meeting in the city of New Bern in 1908. This Association was organized for the purpose of unifying the public sentiment which had been aroused in recognition of the necessity of land drainage. The thoughtful and progressive citizens of the State were confronted with a remarkable condition, which may be briefly summarized. A careful estimate showed that there were within the State about 2,800,000 acres of unreclaimed wet and swamp lands. These lands constituted the most fertile within its boundaries. In the swamps of the coastal plain, and in the river valleys in the Piedmont section, these lands lay dormant and unprofitable. Their only recognized value consisted in the growing timber which they contained, a large part of which had been removed. Much of this area was formerly owned by the State and by the State Board of Education, and had been sold to individuals and corporations at a low value, the purchasers having no other immediate purpose than the removal of the timber thereon. The same authority estimated that at least 1,000,000 acres of these unreclaimed low lands were susceptible of drainage at a reasonable cost, and the greater part thereof could be drained by gravity. Well might the inquiry arise as to whether this valuable asset was longer to continue undeveloped and unremunerative.

This does not comprise, by any means, all the lands where drainage was demanded. Many acres of the most productive lands were reclaimed years ago and cultivated for generations and was unsatisfactory in its productiveness. In every year of excessive rainfall the growing crops were impaired, their productiveness greatly diminished. How often has the statement been heard, that the early season promised good crops, but the excessive rains in the midsummer "drowned them out"! Farming on such lands in the face of such unsatisfactory conditions was of necessity unprofitable.

Must this more than a million acres of most fertile unreclaimed lands longer remain undeveloped and unprofitable? Must the wet cultivated lands, estimated to contain in the aggregate about six million acres, continue to be cultivated with failure or partial failure of crops every two or three years? There could only be one answer. All of these lands could be successfully drained so as to insure abundant yields every recurring year. There are no engineering problems which have not been solved, as illustrated in other sections and States. The cost of such drainage was within the limits of economical investment and would yield abundant returns.

There was only one phase of the problem, however, involved in the successful drainage of these areas. It has come to be recognized that the problem is beyond the capacity of the individual landowner. This is true, not only because of the cost, but because it was a community problem. The tract of land which can be successfully drained without reference to contiguous lands is very rare. Generally the drainage of one tract is connected with and dependent upon the drainage of other tracts. The dominant landowner must of necessity seek his outlet for drainage through the servient lands, and the latter must take care of the water which flows from the dominant land. It was recognized that only large areas could be successfully

and economically drained, and that the burden must be distributed among all the landowners in proportion as the lands were benefited.

This Association at its first session in New Bern, in 1908, appointed a committee instructed to frame a suitable law. As a result of the efforts thus instituted the General Assembly of 1909 enacted a modern drainage law, which was amended in several respects by the General Assembly of 1911. Under this law fifty-four districts have been started and in some of them bonds have been issued, the drainage works constructed, and the beneficent results are now being recognized. In the others satisfactory progress has been reported. Not the least gratifying feature is the fact that the basic and essential provisions of this law have been upheld and approved by the Supreme Court of the State. This test of the law has not only relieved the apprehension of skeptics, but has satisfied prospective purchasers as to the validity of the bonds issued by the drainage districts. It now only remains to administer the law and to observe with care its several provisions.

The reclamation and effective drainage of wet lands would alone justify the law and the efforts of this Association to promote this important economic movement, but there are at least two public purposes to be subserved by drainage which serve to emphasize its importance. The conservation of the public health is now occupying in a marked degree the attention of the medical man and the layman everywhere. If all the other conditions are favorable, good health can not be maintained in undrained sections. The drainage will eliminate mosquitoes and other insects which propagate disease, will banish malaria, and add to individual efficiency. Again, one of the conspicuous current movements is that seeking to provide better highways. As drainage lies at the base of successful agriculture, it is equally a condition precedent to good roads. No matter how effective the construction, or the kind of materials used, good roads can not be maintained unless the roadbed is drained.

This Association, mindful of the beneficent results to be obtained through drainage, again invites the attention of the people of North Carolina to this work, and seeks their coöperation. While much has been accomplished, more yet remains to be done. "The harvest is ripe, but the laborers are few."

*Resolved*, That we urge the General Assembly to enact appropriate legislation, authorizing the State Geological and Economic Survey to employ one or more competent drainage engineers, and to appropriate a sufficient sum for their compensation and expenses, not less than \$6,000.00. It is to be expected in the initiation of proceedings for the establishment of drainage districts, that encouragement will be necessary in the early stages, and if the State could furnish at this stage a competent engineer to make preliminary examinations and actual surveys with plans and estimates of cost, the movement would be greatly expedited.

*Resolved*, That we commend to the General Assembly the State Geological and Economic Survey as worthy of generous support. It represents some of the most important activities of the people connected with our material upbuilding, and can not render the aid so generally demanded unless it is equipped to make proper response to requests from progressive citizens and sections.

*Resolved*, That we respectfully request the trustees and the president and faculty of the State University, and of the Agricultural and Mechanical



College at Raleigh to establish a chair for instruction in drainage engineering. We believe that these two educational institutions under the jurisdiction of the State should give recognition to the growing demands for this class of engineers. Young men properly trained and equipped will find ready employment and become factors in the restoration of this fertile domain to the State.

*Resolved*, That the State Department of Agriculture be again earnestly requested to establish one, and if possible several, test or demonstration farms so located as to demonstrate the value of the several classes of wet lands. The wet lands in the river valleys of the Piedmont section have properly been recognized in this respect, but the alluvial lands of the coastal plain have been neglected. We respectfully urge that at least one such farm be located in one of the areas of swamp lands which have been recently reclaimed.

*Resolved*, That this Association recommend that the teaching of agriculture in the public schools be extended at least to every rural school, and that school gardens be attached and maintained as the conditions may justify. It is an anomalous fact that the farmer's son should have been taught many of the elementary subjects in the public schools and that the elements of agriculture should have been neglected. The basic things connected with the soil and plant life, if properly taught in the schools, would make the farm more attractive and help to enhance in the estimation of the son the vocation of his father. We commend this subject to the attention of the most efficient State Superintendent of Public Instruction and the local school authorities everywhere.

*Resolved*, That we commend the movement of home seekers to North Carolina, which is making progress. The State needs more folks. We need and we welcome the home seeker who is willing to work and touch elbows with us in the upbuilding of the State. Drainage is the most efficient handmaiden of immigration. We can not expect the best type of home seeker to locate among us if the lands are undrained.

*Resolved*, That the commissioners of any completed drainage district be requested to make a report to the next annual drainage convention following as to what has been done toward putting into cultivation any of the swamp or wet lands in that district, and such other information as may seem of interest or profit.

*Resolved*, That this Association recognize with gratitude the aid which has been rendered to drainage in this State by the United States Department of Agriculture, and we extend cordial thanks to the Hon. James Wilson, the Secretary of Agriculture; to Mr. A. C. True, the Chief of Experiment Stations, and to Mr. C. G. Elliott, the Chief of the Office of Drainage Investigations, the latter of whom has manifested such cordial interest in our drainage problems. To the State Geological and Economic Survey and the Geological Board we are indebted for their active coöperation. While the Board and the State Geologist are limited as to funds and equipment, they have rendered the best service possible with their limited resources.

*Resolved*, That this Association extend cordial thanks to the Board of Commissioners of Pasquotank County, and to the county officials for the use of the commodious and comfortable courthouse, and for other courtesies rendered. To the Chamber of Commerce and the citizens of Elizabeth City we

make grateful and cordial acknowledgment for their hospitality, for the many thoughtful courtesies and comforts provided for the delegates. The President and the Secretary of the Chamber of Commerce have been particularly courteous in their attentions to the delegates and to the Association.

*Resolved*, That we extend thanks to the press of Elizabeth City and to the other papers both in and out of the State for giving publicity to this convention and to its work.

*Resolved*, That we especially commend the activity of the officers of the Norfolk Southern Railroad, who have not only attended the sessions of this convention, but have provided special train facilities for the movement of the delegates to the Moyock and Pungo Drainage Districts, thereby affording most instructive object lessons.

Finally, we commend to thoughtful citizens who recognize the importance of this economic movement of drainage, and to the press the necessity of education and agitation. The result to be attained will compensate many fold for all the civic spirit, labor, enterprise, and capital which may be invested in the work.

The Committee on Nomination and Next Meeting Place then made its report as follows:

#### REPORT OF COMMITTEE ON NOMINATION AND NEXT MEETING PLACE

We recommend Raleigh as the place at which to hold the next convention, the date being left with the President; and the following officers:

PRESIDENT—Joseph Hyde Pratt, Chapel Hill.

SECRETARY—George Boyd, Wilson.

TREASURER—Joseph Hyde Pratt, Chapel Hill.

VICE-PRESIDENTS—One from each of the counties interested in drainage.

ANSON—E. E. Barrett, Polkton.

BEAUFORT—John Wilkinson, Belhaven.

BERTIE—Francis D. Winston, Windsor.

BLADEN—O. L. Clark, Clarkton.

BRUNSWICK—Jackson Johnson, Town Creek.

CAMDEN—W. G. Ferebee, Gregory.

CARTERET—W. S. Chadwick, Beaufort.

CATAWBA—George McCorkle, Newton.

CHOWAN—W. S. Privott, Edenton.

CLEVELAND—W. L. Dameron, Shelby.

COLUMBUS—Joseph A. Brown, Chadbourne.

CRAVEN—G. V. Richardson, Dover.

CUMBERLAND—H. B. Downing, Cedar Creek.

CURRITUCK—A. B. Lukens, Moyock.

DUPLIN—G. M. Houston, Chinquapin.

EDGECOMBE—B. F. Shelton, Speed.

FORSYTH—A. H. Eller, Winston.

GASTON—T. L. Ware, Mt. Holly.

GATES—A. P. Godwin, Gatesville.

GREENE—D. M. Patrick, Snow Hill.

GUILFORD—E. W. Myers, Greensboro.



HALIFAX—Paul Kitchin, Scotland Neck.  
HARNETT—H. L. Godwin, Dunn.  
HERTFORD—R. C. Bridger, Winton.  
HYDE—J. S. Mann, Middletown.  
IREDELL—L. O. White, Statesville.  
JONES—J. H. Bell, Pollocksville.  
LINCOLN—R. M. Roseman, Lincolnton.  
MARTIN—Harry Stubbs, Williamston.  
MECKLENBURG—W. S. Pharr, Charlotte.  
NEW HANOVER—B. F. Keith, Wilmington.  
ONSLow—E. M. Koonce, Jacksonville.  
PAMLICO—G. T. Farnell, Bayboro.  
PASQUOTANK—Dr. L. S. Blades, Elizabeth City.  
PENDER—A. B. Croom, Jr., Burgaw.  
PERQUIMANS—E. E. Everett, Hertford.  
PITT—John T. Thorne, Farmville.  
ROBESON—J. B. Sellers, Lumberton.  
ROCKINGHAM—R. P. Richardson, Reidsville.  
ROWAN—P. B. Beard, Salisbury.  
SAMPSON—V. T. Baggett, Salemburg.  
TYRRELL—John Pinner, East Lake.  
WASHINGTON—N. H. Harrison, Pinetown.

This report was adopted and those nominated were unanimously elected.

The Convention then adjourned *sine die* at 12:15 o'clock.

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A large number of the delegates availed themselves of the opportunity to visit the Moyock Drainage District in Currituck County. A special train left over the Norfolk-Southern Railroad at 1:30 o'clock for Moyock; stopping en route where the railroad crossed one of the drainage canals. At Moyock a special logging train of the Provident Land Company met the delegates and conveyed them to the swamp, where the visitors had a chance to see one of the dredges at work; and also to see some of the reclaimed land. It was a very enjoyable and instructive trip.

The following excerpt from the *Norfolk Landmark* of November 18, 1911, indicates the interest that other States have in the drainage work of North Carolina.

#### DRAINAGE IN CAROLINA

The North Carolina Drainage Convention, held during the current week at Elizabeth City, was an unqualified success. The reports of what has been accomplished since the Association became legally organized in 1909 almost tax credulity.

It has never been a secret that in Eastern North Carolina there were lands

of indescribable richness, waiting only to be freed from their burden of saturation. It was known that the swamps concealed fields that promised the most ample yields, acres by the thousand that would respond nobly to the call of agriculture.

But the acres waited for centuries and the swamps remained soggy and forbidding. Men have talked reclamation, iterating and reiterating their theories and proclaiming their intentions. Desultory experiments have been made at various times and all of them have been successful; but these were private enterprises and conducted on limited scales.

With the advent of the Drainage Association a new era opened for North Carolina. The academic and abstract arguments were transmogrified and became practical and concrete. Sections which had debated canals began to see canals, more than a hundred miles of them, planned by the association and finished by it.

To the productive area of North Carolina thousands of acres have been added, acres whose soil continues ten feet and more below the surface, acres that will not need an ounce of fertilizer for decades or it may be for centuries. The land may be a trifle sour after its long submergence, and lime would be desirable to correct that feature; but within the earth is all that nature wants to bring forth luxuriant crops.

The almost limitless potentialities of this drainage project can be understood when it is known that North Carolina has nearly three million acres of swamp land, all of it lying within the great Atlantic littoral that constitutes a trucking section whose superior can not be found upon this globe. Upon some of these cleared lands an average of more than a hundred bushels of corn to the acre has already been made, and the cultivation has not been notably scientific. What would be the money value and the food value of this great reclaimable area may be predicated, however, from this result which has already been attained.

Now the Association asks the State to help the great work. It has resolved to memorialize the Legislature for aid and encouragement along several lines. It petitions for a small financial assistance and some educational effort.

The General Assembly will be requested to enact legislation that will enable the State Geological and Economic Survey to employ a competent engineer, or possibly several of them, to take charge of the work and proceed upon a strictly scientific course of development. The sum that is estimated as sufficient for salaries and expenses is placed at \$6,000 minimum; and certainly the rich North State can well afford the investment.

The trustees of the University of North Carolina and the trustees of the North Carolina Agricultural and Mechanical College will be requested to establish chairs for the instruction of drainage engineers. This request is not too exigent. In the face of such an immediate, prospective, local demand for the graduates of such courses, it would be odd if the trustees of these institutions failed to accede.

The State Department of Agriculture will be asked to establish test farms or stations for the purpose of demonstrating the values of the several classes of reclaimed lands. This work would necessarily inure greatly to the advantage of entire districts and could not fail to benefit the agriculture of the State.

The other recommendation of the Association deals with an economic phase



which is so patently desirable that it will surely be undertaken sooner or later. The problem of expense may curtail the fulfillment of the entire plan, but its wisdom or expediency can not be assailed. It is recommended by the convention that the teaching of agriculture be extended at least to all rural schools—if possible to all the schools, and that school gardens be attached to the country institutions for teaching the young.

When it is known that the State Immigration Commissioners, now in session in Washington, proclaim that the greatest need of the present time in an industrial way is for farm workers, and that no other sort of work offers such opportunities for unskilled labor, it may be realized just how much a State will benefit by encouraging a love for the farm.

Land yields almost in direct proportion to the intelligence that is put into its cultivation. The day has departed when the farmer ridiculed all that he did not understand and condemned innovations as new-fangled. He now appreciates the necessity for concentration, for intensive work, for making the largest possible crop on the least acreage. He has come to that conclusion by reason of the glaring insufficiency of labor. Even his own sons want to leave the farm as soon as they are large enough to travel from their homes.

The children of intelligent farmers are apt to be intelligent. If they are taught the scientific side of agriculture, if they are made early in life to appreciate that growth is not haphazard, they will take a more keen interest in the ploughing, the planting, the care, and the harvest. Every farmer in the State should be found aligned with the drainage advocates in their request to the State Board of Education.

The various resolutions of the Drainage Convention illustrate the modesty of men who achieve things. They are asking nothing unreasonable. They are not blowing their own horns, nor praising their achievements. They have accomplished great deeds, and they let those deeds speak for themselves. What they want the State to do, old North Carolina, progressive and prosperous, can do most easily.

If undertakings like those inaugurated and completed by the Drainage Convention are much in evidence, there will be no need for an aggressive back-home campaign. Expatriates and aliens will flock to a State which is doing real things.

Although North Carolina drainage bonds have been on the market but two years, yet on account of the collateral back of them, the decisions of the Supreme Court regarding their validity, and the amount of interest they bear, they are becoming very much in demand. The last issue sold (those of the Dover Creek Drainage District, of Craven County), brought a premium. In this connection the following excerpt from the *Wilmington Star* of November 25, 1911, will be of interest:

#### GILT EDGED DRAINAGE BONDS

As the original drainage paper, the *Star* desires to call attention to a high class investment furnished by drainage bonds. In the first place, no bonds are backed by such absolutely safe security values as are drainage bonds. In the second place, they pay a higher rate of interest than the ordinary bond

not half so substantially secured. That makes them not only a solid but inviting class of investment.

Drainage bonds are strongly secured on account of the fact that their security lies in their being a first lien on the lands in an organized drainage district, such as are created in North Carolina under the act of the General Assembly. Drainage bonds constitute a high-class investment because the funds for which they are sold are invested in improving the lands which are back of them as surety. Lands so improved increase tremendously in value, hence the drainage of land proportionately increases the security of the bonds. We make that assertion and we furnish the proof.

Near Wilmington, in Bladen County, there is a rich alluvial area known as White Oak Swamp. A drainage district was organized there by landowners under the law for the purpose of cutting canals and dyking them in order to drain them for the purpose of agriculture. The assessed value of the land as security for the bonds was \$20 per acre. Since the drainage scheme has been completed the value of the lands is estimated at \$100 per acre, for the landowners are not anxious to sell them even at that price. These lands produce sixty to seventy bushels of corn per acre without fertilizer, and some of them are the finest cotton lands in the South. That fixes their value, and if such lands were valued at only \$40 the acre it would double the security of the White Oak bonds. If that isn't gilt edge security, what is?

Thus we observe that the drainage bondholder is amply secured by the positive and increased value of his security, but it is the landowner who reaps the greatest benefit. He pays a small tax on the drainage bonds, and if his lands only double in value he comes out the biggest sort of winner. If his bond tax were one-half of one per cent, and the increased value of his land one hundred per cent, it makes his expense the merest bagatelle. About 240,000 to 250,000 acres of North Carolina's 3,000,000 acres of rich swamp lands have been drained, and in no instance is there anything but a tremendous increase in the value of the land. This all goes to show how solid an investment is the drainage bonds issued under North Carolina's drainage act.

Since the bondholder is doubly secured and the landowner is tremendously benefited by his increased land values, there should be increased interest in drainage projects throughout North Carolina. Money should be easily obtained on such strong security, so there is nothing the matter with going right ahead in the work of draining North Carolina's immensely fertile swamp and bottom lands.

Since the passage of the North Carolina Drainage Law, there has been added to our agricultural area not less than 240,000 acres of the most fertile land in America. If we estimate the value of these reclaimed lands at only \$40 an acre, we see that we have added nearly ten million dollars to the land values of the State. Drainage looks good to us. Doesn't it look good to you?



PUBLICATIONS  
OF THE  
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

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BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
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10. Gold Mining in North Carolina and Other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesium Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
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19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglas B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
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21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
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2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

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5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Mineral and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.



15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

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24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

25. Proceedings of Second Annual Convention of the North Carolina Forestry Association, held at Raleigh, North Carolina, February 21, 1912. Forest Fires in North Carolina During 1911. Suggested Forestry Legislation. Compiled by J. S. Holmes, Forester, 1912. 8°, 71 pp. *Postage 6 cents.*

26. Proceedings of Fourth Annual Drainage Convention, held at Elizabeth City, North Carolina, November 15 and 16, 1911, compiled by Joseph Hyde Pratt, State Geologist, 1912. 8°, 45 pp. *Postage 5 cents.*

27. Highway Work in North Carolina, containing a Statistical Report of Road Work during 1911, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, 1912. 8°, .... pp., .... figs. *Postage .... cents.*

#### VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Coastal Plain Deposits of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson, and Horatio N. Parker, 1912. 8°, 509 pp., 62 pl., 21 figs. *In Press.*

Pt. I.—The Physiography and Geology of the Coastal Plain of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller, and L. W. Stephenson.

Pt. II.—The Water Resources of the Coastal Plain of North Carolina, by L. W. Stephenson and B. L. Johnson.

## BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

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Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

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Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Gives special report on an Examination of the Sand-banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report. Contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract, Buncombe County; Transylvania County State Farm; certain Watersheds; Reforestation of Cut-over and Abandoned Farm Lands; on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county seats in North Carolina; list of Magnetic Declination at the county seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

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Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump



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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

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ECONOMIC PAPER No. 27

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# HIGHWAY WORK IN NORTH CAROLINA

CONTAINING

A STATISTICAL REPORT OF ROAD WORK  
DURING 1911

BY

JOSEPH HYDE PRATT, State Geologist

AND

MISS H. M. BERRY, Secretary



RALEIGH

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## LETTER OF TRANSMITTAL.

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CHAPEL HILL, N. C., June 1, 1912.

*To His Excellency, W. W. KITCHIN,*  
*Governor of North Carolina.*

SIR:—I beg to submit herewith for publication as Economic Paper No. 27 a report on the Highways of North Carolina, which also contains a Statistical Report of the Road Work done during 1911. This report is intended to give a rather comprehensive survey of highway conditions in the State, and it is believed that it will have a wide scope of influence, not only because of its historical and statistical value, but because of the practical advice given regarding the construction of certain kinds of road.

Yours respectfully,

JOSEPH HYDE PRATT,  
*State Geologist.*





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## PREFACE.

The road work in North Carolina has reached such proportions as to warrant a rather comprehensive report on the progress she has made and her present status in this progressive movement. The North Carolina Geological and Economic Survey has been collecting monthly data for two years in coöperation with the United States Office of Public Roads, and has also collected statistics regarding road work during the years 1908, 1910, and 1911. Bringing this data together in one report and analyzing it has revealed the following facts with regard to road work in North Carolina:

That North Carolina spent during the past year a direct tax of \$1,466,354; a labor tax equivalent to \$916,003 (including free and convict labor); making a total of \$2,383,157 on her roads in maintenance and the construction of new roads.

That the present system of maintenance results in nothing of permanent value and seldom affords temporary relief from bad road conditions; so that the enormous expenditure for this purpose is practically thrown away.

That the present system of bad roads at a low estimate is annually costing the people of the State over \$12,000,000 in increased cost of haulage over the cost of hauling a similar load over an improved road.

That the most glaring defect in our present system of road construction and maintenance is the class of road officials selected, *i. e.*, placing the work of road location, construction, maintenance, and the handling of road funds in the hands of men untrained for this kind of work.

That the most efficient aid which a State can render its counties is by furnishing road engineering assistance to them. The use of a State highway engineer in county work would insure to the county the proper location of its roads and expenditure of its funds regardless of petty local politics or influence.

That the State could very soon check this terrific drain on its citizens by the annual expenditure of \$50,000 for the maintenance of a State Highway Department, which would furnish engineers for highway location, construction, bridge construction, etc.

That with the privilege of such aid the counties would be encouraged to issue bonds or raise money in other ways to construct good roads throughout their borders.

Shall we continue a system by which we are annually losing something like \$13,000,000, or shall we, by a direct State appropriation of a sum meager in comparison, check this drain upon our State and her resources?

Certain proposed laws are given at the end of this report, which, if passed, it is believed will cause not only every dollar of tax money, of bond money, and every day of convict labor, to be spent to the best advantage and thereby insure well-constructed roads, but will encourage the various counties and townships to increase this expenditure, because they will feel that they are getting value received.

JOSEPH HYDE PRATT,

*State Geologist.*









FIG. 1.—Craggy Pinnacle, elevation 5,900 feet, and Craggy Dome, elevation 5,105 feet. In the region of the Crest of the Blue Ridge Highway.



# HIGHWAY WORK IN NORTH CAROLINA.

## CONTAINING A STATISTICAL REPORT OF ROAD WORK DURING 1911.

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By JOSEPH HYDE PRATT AND MISS H. M. BERRY.

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### INTRODUCTION.

There is perhaps no State in the Union which has so varied conditions to contend with in highway construction as North Carolina. Extending from the coast westward for a distance of over 500 miles, it embraces within its borders every variation in topography from the lowlands of the coastal plain region and the rolling section of the Piedmont plateau to the steep mountain ranges of western North Carolina. Similar wide variations are to be found in its climate and geological formations. All these conditions make the highway problems of the various counties more complex, and each section has its own problems with regard to location, drainage, surfacing materials, and maintenance. Thus, according to the section of the State in which the county is located, it is found advisable to use macadam, gravel, or sand-clay. Nature has come to our assistance, however, in providing very abundantly the surfacing materials necessary to make a sand-clay road. Experiments have shown that this road when properly constructed gives almost perfect satisfaction, and when kept with a hard smooth surface the cost of hauling over it is only 8 cents per ton per mile, which is the same cost as hauling the same load over the best macadam; and that it will withstand the traffic of wagons and automobiles fully as well as the macadam, but has to be maintained a little more constantly. In eastern North Carolina the sand-clay road is becoming the universal good road, and its cost in this section is about one-fifth to one-sixth that of the macadam. As we approach the center of the State, however, we find more macadam and gravel roads, and, in the west central and western parts of the State a still larger percentage of macadam. Experiments have also shown, however, that the sand-clay road can be constructed and maintained in central and western North Carolina just as satisfactorily as in the eastern part of the State, and now this type of road is being constructed over a large part of the State, especially in those portions of the counties more remote from the large towns.

The present status of road improvement in the State can best be correctly understood when interpreted in the light of past experience. Because of the number of calls for literature giving the history of road work in North Carolina, the following brief sketch has been prepared:

#### HISTORICAL SKETCH.

Early in the last century, Archibald D. Murphey, Joseph Caldwell, and other far-seeing North Carolina statesmen, devoted a large share of attention to the subject of public improvements, including principally better facilities for transportation on the rivers of the State and the opening of the public roads.

As early as 1819, and at intervals for nearly half a century thereafter, the General Assembly of the State, through its Board of Internal Improvements, coöperated with the local authorities in having public roads surveyed and constructed in many portions of the State. In 1822 the engineer of this Board of Internal Improvements, Hamilton Fulton, who was a really great man, recommended the adoption by the State of a regular system of public roads, to be divided into three classes: (1) The principal thoroughfares, to be called "State roads"; (2) those of secondary importance, to be called "county roads"; (3) those of least importance, to be called "private roads."

This was ninety years ago, but it was not until 1911 that the idea of a State road was carried out, when the General Assembly of 1911 passed bills designating the Central Highway and the Charlotte-Wilmington Highway.

In 1849 the people of the Cape Fear section became interested in a system of plank roads, and a number of such roads were constructed, radiating out from Fayetteville as a center. The construction of these plank roads was under the management of stock companies, three-fifths of the stock being subscribed by the State and two-fifths by the citizens of the county. The average cost of these roads was about \$1,300 per mile, and, for a time, they were eminently satisfactory, but, as an investment, they were not profitable; consequently, they were not repaired and in a decade or so were entirely abandoned. Unfortunately, the plans and recommendations of this Board of Internal Improvements were carried out only in part. Toward the middle of the century, the people of the State became more especially interested in railway construction, and many of the prominent citizens came to believe that the construction of railroads would, in a measure, do away with the need of wagon roads. Then came the Civil War, and following that the period of reconstruction, and it was not until twenty years after the outbreak



of the Civil War that the attention of our people, even in the better counties, was again seriously given to the improvement of public highways.

During the past two decades and a half we have been passing through a transition stage in public road building in this and other Southern States, and it is only within the past three or four years that the majority of our counties have begun to realize the vital importance of a system of good roads for the whole county. Nothing indicates the nature of the transition referred to above so clearly as a review of the legislation relative to our public road building in several counties of the State during this period. The movement has oscillated forward and backward like the pendulum of a clock, except that the forward movements have been greater than the backward, and the collected result has been a decided advance, until now practically the whole movement is a forward one and the only backward steps are those caused by the inertia of certain Rip Van Winkle counties.

The modern movement for better roads in North Carolina may be said to have begun in 1879, when the General Assembly passed what is known as the Mecklenburg Road Law. This was enacted as a general State law, but at the time it was applied to only three counties—Mecklenburg, Forsyth, and Stokes. It provided for the working of public roads partly by taxation and partly by the old labor system; but, even in this moderate form, it was ahead of its time, and in 1881 was repealed. It was reenacted by the Legislature of 1885, and since that time, though applied in full to but a few counties, it has served as a basis for much of the best road legislation and road work in the State.

The deep-rooted opposition to all forms of taxation by the people of North Carolina has been the great barrier to anything like general or uniform road legislation in the State; consequently, in all attempts at general road laws by the Legislature so many counties have been withdrawn from the tax provision of the bill that, when these laws were finally entered upon the statute-books, they have applied to a few counties only and sometimes to but a single county. This is a too common occurrence in North Carolina's legislative history.

The Legislature of 1899 placed upon the statute-books two general satisfactory road laws. One of these, which is known as the new Mecklenburg Law, applies to but a few counties, but it can be adopted as the road law of a number of additional counties by a vote of the county commissioners in each of these counties. The other, known as the General Road Law, 1899-1901, applies to about fifteen counties and can be adopted by others by a vote of the county commissioners on petition signed by a number of freeholders in each of these counties.

In the past ten years quite a number of counties have realized that properly built roads can be secured only through the expenditure of considerable sums of money, and have decided to take hold of the proposition of road building in a businesslike manner. In some cases special taxes have been voted, and in other counties the bond issue has been the method employed.

#### EDUCATIONAL WORK.

The good roads movement in North Carolina has received much of its impetus through the educational campaign carried on; first, by the North Carolina Geological Survey and its successor, the North Carolina Geological and Economic Survey, and, secondly, by the untiring efforts of the North Carolina Good Roads Association. This Association was organized in 1902 at a convention held in Raleigh, N. C. The work of the Association has been carried on in coöperation with the Geological Survey mainly by holding conventions and issuing circulars, which latter have been distributed widely throughout the State and have also been given further publicity through the columns of the newspapers of the State. Another feature which the North Carolina Good Roads Association has emphasized in its work is the organization of County and Township Good Roads Associations. Up to January 1, 1911, sixty-two County and Township Good Roads Associations had been organized in the following counties: Anson, Beaufort, Buncombe, Burke, Camden, Carteret, Catawba, Chatham, Chowan, Columbus, Craven, Cumberland, Currituck, Davie, Davidson, Duplin, Durham, Forsyth, Gates, Granville, Guilford, Halifax, Harnett, Haywood, Hertford, Johnston, Jones, Lee, Lenoir, Macon, Madison, Martin, Mecklenburg, Mitchell, Montgomery, Moore, McDowell, Northampton, Orange, Pasquotank, Pender, Person, Perquimans, Pitt, Randolph, Richmond, Robeson, Rockingham, Tyrrell, Union, Wake, Washington, Wayne, Wilkes, and Yadkin. The principal points which are being advocated by the members of these County Associations and also the State Association are:

(1) To secure sufficient funds for the construction and maintenance of roads, either by a special tax or, what is considered the better plan, by a bond issue.

(2) The adoption of a road law with such requirements as are needed to meet the conditions of the county.

(3) The employment of a competent road engineer to locate and construct the roads.

(4) To advocate the use of convicts in public road construction.

(5) To erect sign-posts at all crossroads.



(6) To maintain the roads after they are constructed and also to maintain the dirt roads. This is one of the most important measures advocated.

Another organization which has accomplished a great deal, especially for western North Carolina, is the Southern Appalachian Good Roads Association, organized in 1909. This Association has not only aroused considerable interest in the construction of good roads in the mountain region of the State among the inhabitants of that region, but has interested people from other States in this section and its development. As a result of the work of this Association there are a number of through highways, intercounty and interstate, which are now in process of construction or are being located. These will be taken up in detail under "Special Highways."

#### GOOD ROADS TRAINS.

One educational feature which has been employed during the past year, not only in North Carolina, but in other Southern States, is the Good Roads Train, this having been operated both by the Southern Railway and the Atlantic Coast Line Railway. The train consisted of three coaches, one of which was a lecture car containing a stereopticon and screen arranged so as to show views of good and bad roads, which were used to illustrate points brought out by the lecturer. This car was used when the officials of the train were unable to secure moving-picture halls in the town visited. One car contained working models and exhibits of road-building materials, explaining how to build different roads and maintain them, and working models of road-building machinery. The railway officials were accompanied by experts from the U. S. Office of Public Roads, who gave lectures at all points visited by the train. It was felt by the officials of these railways that the expenditure incurred in operating such a train would be more than compensated for by the great benefit to the people of the South if it could be the instrument of helping them to secure a better system of public roads. It is the experience of railroads that in sections where there are good public roads the population is increased, the land values are increased, and the produce from the farms is enormously increased; and therefore it is to the direct interest of the railroads to help the people to secure a system of good roads. With a system of good roads it is possible for the farmer to market his produce at all times during the year and thus keep up a steady traffic; whereas with the bad roads it is possible for them to get to market only at certain times, which results in congested freight at certain times and very little freight at others.

The points visited in North Carolina by the Southern Railway were:

Marshall, Madison County,  
Asheville, Buncombe County,  
Waynesville, Haywood County,  
Sylva, Jackson County,  
Bryson City, Swain County,  
Andrews, Cherokee County,  
Murphy, Cherokee County,  
Saluda, Polk County,  
Hendersonville, Henderson County,  
Lake Toxaway, Transylvania County,  
Brevard, Transylvania County,  
Rutherfordton, Rutherford County,  
Marion, McDowell County,  
Newton, Catawba County,  
Morganton, Burke County,  
Statesville, Iredell County,  
Taylorsville, Alexander County,  
Mocksville, Davie County,  
Winston-Salem, Forsyth County,  
North Wilkesboro, Wilkes County,  
Mount Airy, Stokes County,  
Walnut Cove, Stokes County,  
Reidsville, Rockingham County,  
Siler City, Chatham County,  
Sanford, Lee County,  
Greensboro, Guilford County,  
Asheboro, Randolph County,  
Lexington, Davidson County,  
Concord, Cabarrus County,  
Albemarle, Stanly County,  
Graham, Alamance County,  
Hillsboro, Orange County,  
Chapel Hill, Orange County,  
Durham, Durham County,  
Raleigh, Wake County,  
Selma, Johnston County,  
Goldsboro, Wayne County,  
Henderson, Vance County,  
Oxford, Granville County.



The points visited by the Atlantic Coast Line Railway were:

Weldon, Halifax County,  
Halifax, Halifax County,  
Enfield, Halifax County,  
Whitakers, Edgecombe County,  
Rocky Mount, Edgecombe County,  
Nashville, Nash County,  
Tarboro, Edgecombe County,  
Scotland Neck, Halifax County,  
Gates, Gates County,  
Tunis, Hertford County,  
Ahoskie, Hertford County,  
Kelford, Bertie County,  
Williamston, Martin County,  
Plymouth, Washington County,  
Washington, Beaufort County,  
Aurora, Beaufort County,  
Vandemere, Pamlico County,  
Greenville, Pitt County,  
Kinston, Lenoir County,  
Wilson, Wilson County,  
Kenly, Johnston County,  
Smithfield, Johnston County,  
Dunn, Harnett County,  
Fayetteville, Cumberland County,  
Fremont, Wayne County,  
Mount Olive, Wayne County,  
Warsaw, Duplin County,  
Clinton, Sampson County,  
Rose Hill, Duplin County,  
Burgaw, Pender County,  
Wilmington, New Hanover County,  
Jacksonville, Onslow County,  
Pollocksville, Jones County,  
New Bern, Craven County,  
Whiteville, Columbus County,  
Chadbourn, Columbus County,  
Rowland, Robeson County,  
Pembroke, Robeson County,  
Red Springs, Robeson County,  
Maxton, Robeson County,

Wagram, Scotland County,  
Laurinburg, Scotland County,  
Gibson, Scotland County,  
Wadesboro, Anson County.

#### SPECIAL HIGHWAYS.

Five years ago barely two counties in the State were connected with each other by good roads, although many counties had at that time begun good road construction. It seems to have been the idea that it was not advisable to extend these good roads to the county line for fear that some of its trade might go over to an adjoining county. Fortunately, however, this attitude has entirely changed in nearly all the counties, and now one hears on all sides discussions regarding the construction of intercounty roads connecting county seat with county seat and mountains with the seacoast. We are also hearing a great deal of interstate roads, such as the National Highway, the Capital Highway, the Quebec-Miami Highway, etc., all of which are of interest to North Carolina, as they traverse this State. Such intercounty and interstate highways are now being surveyed and located, which, when constructed, will connect the seacoast with the mountains; will connect North Carolina with Virginia on the north, with South Carolina and Georgia on the south, and with Tennessee on the west.

The principal one of these highways and the one which has attracted most attention in North Carolina up to the present time, is the Central Highway. This was authorized by the Legislature of 1911, Public Laws for 1911, chapter 58, page 195. In May, 1911, the committee began its first tour over this highway at Morehead City, Carteret County. This committee was accompanied by the State Geologist, and used an automobile furnished by the J. I. Case Threshing Machine Company. Because of the importance of this highway, it is described in considerable detail.

#### CENTRAL HIGHWAY.

The highway starts at Beaufort Harbor, Carteret County, at present from Morehead City, where is located the large Atlantic Hotel, which is probably the most popular and celebrated summer hotel on the North Carolina coast. On an island in Beaufort Harbor is the U. S. Biological Laboratory, which is open throughout the whole year and during the summer months is filled with investigators from all parts of the country. On the banks near the entrance to the harbor is the historic Fort Macon.

Leaving Morehead City on a shell road, the traveler soon strikes a hard, smooth sand-clay road built during 1911. This road is in sharp



contrast to the heavy sand roads coming into it on either side. The work on this road will be continued until it reaches Newport on Newport River, 8.6 miles, and the Craven County line, a distance of 10 miles. It passes through some of the open pocosons and some of the heavily timbered cypress swamps of Carteret County, but the roadbed will be smooth and hard and the traveler will be awed by his surroundings and marvel that the road has been built. If the traveler desires, he can arrange at Newport for a guide and conveyance to take him out into these swamps, where bear, deer, wildcats, and alligator are to be found, as well as ducks and other game birds.

From the Craven County line to New Bern, the county seat of Craven County, a distance of 20 miles, the road is now being constructed, and is of sand-clay. It does not pass through as much swamp land as the road between Morehead City and the county line, but splendid agricultural land is to be seen, which is being very profitably cultivated. Just before reaching New Bern the road cuts through the old embankments that were built during the Civil War to protect the city. New Bern is at the head of navigation of the Neuse River and is delightfully situated on a peninsula between the Neuse and the Trent rivers. The traveler will find the Gaston a delightful hotel, where he will be well taken care of, and from the dining-room on the third floor there is a splendid view down the Neuse and up the Trent rivers.

About two miles out of New Bern is the Federal Cemetery, which is connected with the city by a shell road which is maintained by the Government.

From New Bern to Kinston, Lenoir County, a distance of 35 miles, the highway when completed will be a sand-clay road, passing through Jasper and Fort Barnwell and crossing the Neuse River at Carmack's Ford, and then following up the Neuse valley to Lenoir County. The road passes through some of the best agricultural land of Craven and Lenoir counties, and, while the country is flat, it is very attractive and the ride is in nowise tiring or uninteresting.

At Kinston the Hotel Tull is ready to receive the tourist, and the management desires its guests to complain if they are not satisfied with what they receive. In all this lowland of North Carolina artesian water is abundant and nearly all the towns are supplied with it. At Kinston any one interested in seeing a flowing artesian well will be repaid by visiting the city waterworks, where three or four wells are constantly discharging their supply of pure water into the reservoir, from which it is pumped into the distributing tanks.

From Kinston to Goldsboro, Wayne County, 29 miles, via LaGrange, the road was originally through an almost continuous stretch of deep



sand which is now being replaced by a sand-clay road. Notwithstanding the great quantity of sand that seems to exist in this section and which to the ordinary traveler would seem to exclude all chance of any clay, there is close by sufficient clay to make a good and satisfactory sand-clay road.

If one desires, a detour can be made from LaGrange to Goldsboro via Seven Springs, a summer and winter resort, where the traveler can quench his thirst with one or all of seven varieties of mineral water. Goldsboro is the metropolis of Wayne County, and is near the center of the big trucking and berry section of North Carolina. The Kennon Hotel offers some inducements to travelers to stop with them, and usually gets them.

Leaving Goldsboro, the route to Raleigh, Wake County, 46 miles, is via Princeton, Smithfield, and Clayton, Johnston County, and Auburn and Garner, Wake County. The road is well graded and is of sand-clay nearly the whole distance.

The section of North Carolina passed over thus far is in the cotton belt of the State and during the latter part of August and of September the white cotton-fields are an additional attraction to the traveler.

Raleigh, the capital of the State, is not only on the Central Highway, but also on the Triangular and Capital to Capital Highways, which are described beyond. One noticeable thing about Raleigh is its number of educational institutions, including the State College of Agriculture and Mechanic Arts, St. Mary's School, Peace Institute, Meredith College, and Shaw University (negro school). The State Capitol is not a large building, but is considered an architectural gem. Any one interested in the resources of the State will find these well illustrated in the State Museum. The Yarborough House and the Bland Hotel will do their best to please any tourist or traveler who is willing to pay a fair price.

The next section of the highway from Raleigh to Durham, Durham County, a distance of 26 miles, is located on a ridge and contains very little grade. The road has been partly relocated to eliminate grade crossings and several short and steep grades. In Wake County the road will be of sand-clay and in Durham County it is mainly macadam. This latter county is well covered with a system of fine macadam roads, which, however, in some places are in great need of repair. Durham is the home of the American Tobacco Company, and their large storage warehouses are a conspicuous sight. It has been stated that as high as \$20,000,000 worth of tobacco has been in storage in Durham at one time. The factories which manufacture the well-known Bull Durham smoking tobacco and Duke's cigarettes will be interesting



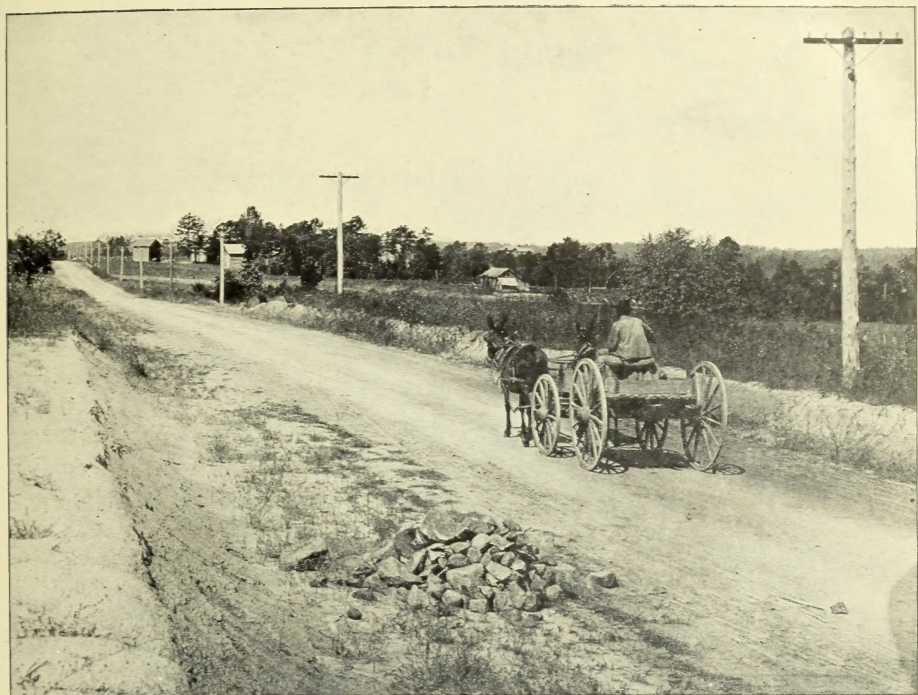


FIG. 2.—Part of the Central Highway between Durham and Hillsboro.

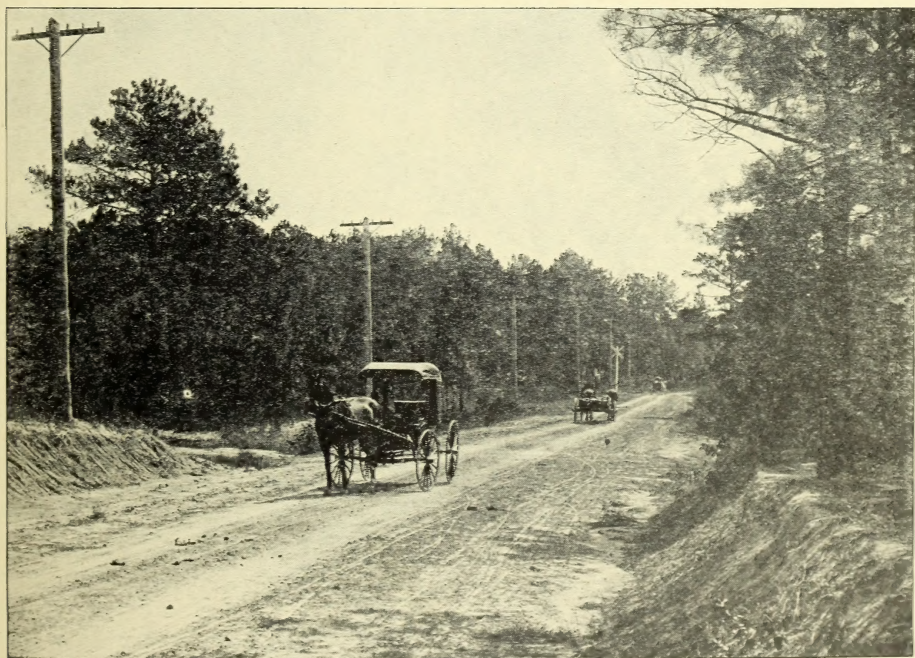


FIG. 3.—Macadam Road in Durham County. On Central Highway between Durham and Raleigh.





places to visit for those who are not familiar with the methods employed in preparing tobacco for market. Hotel accommodations are not very commodious in Durham, but the traveler will find a quiet and satisfactory hostelry at the Hotel Corcoran.

From Durham to Graham, Alamance County, two routes are available—one, via Hillsboro (see Fig. 2), the county seat of Orange County, and the other, via Chapel Hill (see Fig. 3), Orange County. At the present time the best route is via Chapel Hill. From Durham to the Orange County line the road is macadam and from the line to Chapel Hill it is sand-clay. There are a great many beautiful vistas along this road, and, when within one mile of Chapel Hill and immediately after crossing an iron bridge, the road begins to climb a long hill (on an easy grade, however), which is the first hill climbing of any extent that the traveler has encountered since leaving Morehead City. When the top of the hill is reached a splendid view greets the traveler, and he can see across the broad valley nearly as far as Raleigh. Chapel Hill, the seat of the State University, is located on the summit of a long, high hill, and the highway passes through the main street of the town. Entering from the east, the broad street, with its beautiful homes and well-kept yards on each side, gives some idea of the beauty and dignity of this delightful old town. Sufficient time should be taken to ride through the campus of the oldest State University in the country. Just before reaching the center of the town, the Episcopal Church will be passed. This beautiful, ivy-covered building attracts the attention of all who pass and reminds one of old English churches. It was designed by Upjohn, the architect who designed Old Trinity Church of New York.

As one leaves Chapel Hill and rides toward Saxapahaw, Alamance County, he realizes that he has entered the rolling and hilly country of the Piedmont Plateau region. The highway, however, will take the hills by easy grades and the scenery claims the attention of the traveler for the whole distance. At Saxapahaw the road twines down to Haw River, which is crossed on an iron bridge. This little mill town, situated about 9 miles from a railroad, is a city unto itself.

The road from Saxapahaw to Graham has just been completed and is partly sand-clay and partly macadam.

The other route from Durham to Graham, via Hillsboro, passes through West Durham, where the large Methodist College (Trinity) is located. The road to the Durham line will be macadam and across Orange County it will be gravel or sand-clay. Within a few miles of Hillsboro the road passes through two of the noted farms of the State, the Duke farm and the Occoneechee farm. Hillsboro was formerly

the capital of the State, and contains many very attractive old homes. Cornwallis began the construction of paved roads at Hillsboro during the year 1780 of the Revolutionary War, when he had his army quartered for the winter at that place. At the time the roads were practically impassable and he had his soldiers fill the mudholes with rocks. While it did not make a smooth or good road, it did make them passable, so that he was able to haul his cannon and wagons. Some of Cornwallis's road improvement is still to be seen. Most of it, however, has been replaced recently by a good macadam. This old historic town is well worth a visit by the tourist, and most delightful accommodations can be had at the Corbinton Inn.

On leaving Hillsboro the road to Mebane is very hilly and rough, but a new location has been made and the new road should be finished within the next year.

At nearly every town that the highway passes through since leaving Raleigh are one or more cotton mills, and these mills continue to be conspicuous landmarks until the highway passes Mooresville and Statesville. At West Durham the Erwin Cotton Mills represent the largest in the South and one of them covers a greater area than any other cotton mill in the country.

At Mebane is the plant of the White Furniture Company. This is the beginning of a series of furniture factories that will be observed in many of the towns from this point westward. From Mebane the highway passes through Haw River to Graham, where it intersects with the Chapel Hill road. On leaving Graham the traveler will find a splendid macadam road for a distance of 50 miles, passing through Burlington and Elon College, Alamance County, and Gibsonville, Greensboro, Jamestown, and High Point, Guilford County. At Greensboro, the county seat of Guilford County, the Central Highway intersects the National Highway and the two highways coincide as far as Landis, Rowan County, 62 miles to the south. Good hotel accommodations can be obtained in Greensboro, at the Guilford and McAdoo hotels. The State Normal College, the Greensboro Female College, and the A. and M. College for the colored race are located in this city. Guilford County received the \$1,000 offered by the *Atlanta Journal* for the county south of Roanoke, Virginia, through which the National Highway passed that had the best roads. The county is keeping up its reputation and still has the best system of roads of any county in the State. The macadam road between Greensboro and High Point, 15 miles, has been treated with tarvia.

It was only a few years ago that High Point was a small village whose only distinction was the fact that it was the highest point on the



Southern Railway between Danville and Charlotte. Now it is the second city in the country in the manufacture of furniture, the only city exceeding it being Grand Rapids, Michigan. Soon after leaving High Point the Highway enters Davidson County, and the roads during rainy weather have caused travelers a great many anxious moments. The route through this country has recently been resurveyed and the long hills have been eliminated. Revenue will also be available to convert the heavy clay road into a beautiful, smooth, sand-clay road. People who have driven across Davidson County have not had an opportunity to appreciate the beauties of the county, as their thoughts have been too much centered on the road. Another six months will see the road in good condition, and then the traveler will realize that he is passing through a most delightful section of the State, where productive and prosperous farms are very numerous, and, with the beautiful views from the ridge and up the long rich valleys, will impress one that this county is one in which it would be good to live. Thomasville and the county seat, Lexington, are two rapidly growing towns of this section. Lexington Township has recently issued \$100,000 in bonds for the construction of good roads.

Just before reaching the Yadkin River, which is the boundary line between Davidson and Rowan counties, the highway passes near the Daniel Boone Memorial Cabin, which marks the birthplace of that great American pioneer and noted character in American history. Yadkin River is crossed by a tollbridge, but plans are now under way to have a free bridge across this river. At the time of the Automobile Run from New York to Atlanta under the auspices of the *New York Herald* and the *Atlanta Journal*, this tollgate at the end of the bridge was the only tollgate that was raised without charging the tourists toll.

First-class sand-clay and macadam roads are again encountered as the highway reaches Rowan County. The steep hill immediately beyond the bridge will soon be a thing of the past. A new location has been surveyed for the highway, and the new road will be ready by spring. For the next 50 to 60 miles the highway is a joy to all who ride over it, smooth surface and easy grades. Spencer, where are located the large shops of the Southern Railway, is soon passed and Salisbury is in sight. This town, the county seat of Rowan County, is of historic interest in connection with scenes enacted during the Civil War. One of the Confederate prisons was located here. One of the Federal cemeteries is at Salisbury, and, during the past few years, several very handsome monuments have been erected by Northern States to the memory of their soldiers buried at this place.

At Salisbury the highway again becomes double track, one line going to Newton, the county seat of Catawba County, via Barber Junction and Statesville, the county seat of Iredell County, and the other via China Grove and Landis, Rowan County, and Mooresville, Iredell County.

From Salisbury to Landis the road is principally sand-clay and in splendid condition. Up to this point from Greensboro the highway has been the same as the National Highway. At Landis the highway turns to the west and the road is sand-clay and macadam to Mooresville and to the Catawba-Iredell County line. At Mooresville there is a road leading south via Davidson College to Charlotte, where the National Highway is again intercepted. There is also a macadam road to be built connecting Mooresville with Statesville to the north. The Catawba River is crossed by a new iron bridge that is nearly 75 feet above the river. A road has recently been located from the bridge to Newton which eliminates all grades over 5 per cent, and the surfacing material will be sand-clay.

From Salisbury to Newton, via Statesville, the Central Highway is already macadamized as far as Statesville, and there is a force now at work macadamizing the road from Statesville to Buffalo Shoals on the Catawba River where the new bridge is being constructed across the river. From Buffalo Shoals to Newton the road is in Catawba County and is now being graded and prepared for a sand-clay surface. Iredell County has recently issued the highest bond issue of any county in the State, the amount being \$400,000.

From Newton to the top of the Blue Ridge in McDowell County, a distance of 85 miles, there is only a few miles of macadam and sand-clay road. A considerable amount of grading has been done, but, in wet weather, the roads are very heavy across Burke and McDowell counties. Provision, however, has been made to put the highway in good condition, and it is expected that by next spring the road will be in very good shape.

From Newton to Hickory the highway follows the ridge and is nearly level all the way. At Hickory there is a good road extending to Lenoir, Caldwell County, and up the Blue Ridge to Blowing Rock, where it connects with the celebrated Crest of the Blue Ridge Highway, which is described beyond. From Hickory to the top of the mountain the road is via Connelly Springs, which is a summer resort and contains a very good mineral spring; Valdesi, which is the center of a part of Burke County where there are a great many vineyards; Morganton, the county seat of Burke County; Bridgewater; Marion, the county seat of McDowell County; Old Fort, which was formerly the terminus of the





FIG. 4.—Swannanoa River Road near Asheville, N. C. Part of the Central Highway.





Western North Carolina Railroad, at which point travelers took the stage to cross the Blue Ridge going to Asheville, Buncombe County. At Old Fort the highway begins to climb up the Blue Ridge, and some of the most beautiful scenery along the whole ridge is from here to Asheville. The road, as surveyed, will pass Round Knob, at which place there is being installed a fountain which will throw a stream of water over 100 feet high. The highway climbs the mountain to Swannanoa Gap at a maximum grade of  $4\frac{1}{2}$  per cent. This section of the road is now being built, and is expected to be open early in the spring of 1912.

At Swannanoa Gap the highway enters Buncombe County, which is the banner county of western North Carolina as regards good roads. It has a first-class macadam and sand-clay road extending from the Gap to the Buncombe County line on the west, the highway passing through Bluemont, at which place are the Assembly Grounds of the Baptist Association of the South; Black Mountain, one of the summer resorts of the mountains, 4 miles to the west of which is Montreat, where are the Assembly Grounds of the Presbyterian Church of the South—a side trip which is very pretty going from Black Mountain to Montreat over a good macadam road and with several miles of drives within the grounds. The highway follows rather closely the Swannanoa River, a most beautiful mountain stream. Within two miles of Asheville the highway passes through Biltmore, the business village or town of the Biltmore (George Vanderbilt) Estate. This estate, consisting of over 125,000 acres, has a great many miles of beautiful road within it, but up to the present time these roads are not open to the automobile traveler, there being but one road, that going to the top of Mount Pisgah, which will be mentioned later.

The road from Biltmore to Asheville is of some interest, inasmuch as it was the first improved macadam road built in Buncombe County and was constructed under the supervision of the Asheville and Buncombe County Good Roads Association, which raised the money to pay for the work by private subscription. Since that time this Association has been constantly at work encouraging the improvement of roads in Buncombe County and western North Carolina, with the result that Buncombe contains the largest number of miles of improved road of any county in the western part of the State and Asheville has become practically the hub of the good road work in that section of North Carolina. The city is most beautifully situated on the hills rising from the French Broad Valley, and, with its attractive hotels—as the Battery Park, the Manor, and Victoria Inn—makes a most delightful

place for the tourist who is automobiling or coaching through the Appalachian Mountains, to make his headquarters.

The route of the Central Highway from Asheville was via Weaverville, Buncombe County, and Mars Hill, Stackhouse, and Hot Springs, Madison County; but, up to the present time, it has been found impossible to provide for the construction of this route beyond Mars Hill, which place will be open next summer and connected with Asheville by a first-class macadam and sand-clay road. The Central Highway is therefore now routed from Asheville via Candler and Turnpike, Buncombe County; and Canton, Waynesville, and Cove Creek, Haywood County. This route is now open and automobiles are making the trip from Asheville to the Tennessee line. The convict forces are at work eliminating bad grades and turns, and macadamizing and sand-claying the roadbed. At Candler there is a pretty side trip over the Vanderbilt Highway from this place to Mount Pisgah. This road is macadamized and open to automobile travel. At Canton is the large pulp mill of the Champion Fiber Company, which is one of the largest pulp mills and tanning plants in the South and is well worth a visit from whoever is traveling through that portion of the State. Waynesville, the county seat of Haywood County, is a very attractive mountain city, with many beautiful drives and several comfortable inns. The road connecting Waynesville and Asheville will be macadamized by spring. From Waynesville to the Tennessee line the highway follows the Pigeon River valley and gorge, and the mountain scenery along this road is wild and picturesque. At the Tennessee line the Sevier County people of Tennessee have planned to meet the highway with a good macadam road leading to Knoxville.

Many results have already come about because of the establishment of this Central Highway, the principal one being the awakening of good roads sentiment in the counties through which the highway has to pass. Burke is the only county which up to the present time has maintained a stolid indifference, and it is hoped that it too will soon realize the great importance of obtaining a good system of roads within her borders.

#### CHARLOTTE-WILMINGTON HIGHWAY.

The General Assembly of 1911 also passed an act providing for the construction and maintenance of the Charlotte-Wilmington Highway.\*

The law provides that this highway shall be "public highway extending from Charlotte in the county of Mecklenburg, through the counties of Mecklenburg, Union, Anson, Richmond, Scotland, Robeson, Bladen, Columbus, Brunswick, and New Hanover, to Wilmington in the county of New Hanover."

\*Public Laws of 1911, chapter 60, page 199.



This highway will connect the county seats of the southern tier of counties with each other. The continuation of this road westward from Charlotte is known as the Charlotte-Asheville Highway, extending through Gastonia, Kings Mountain, Shelby, Rutherfordton, Chimney Rock, Hickory Nut Gap, and Fairview.

#### CREST OF THE BLUE RIDGE HIGHWAY.

Perhaps the greatest undertaking in highway construction that has been begun in North Carolina is the construction of the Crest of the Blue Ridge Highway, which is destined to be one of the greatest scenic roads in America, rivaling those in the Yosemite Valley and the Yellowstone National Park. Although roads built primarily for scenic purposes and for the use of the tourist are common in many countries of Europe, they have not been built to any great extent in this country, and none thus far have been constructed in the Southern Appalachian region. The scenic beauty of this highway will be its most noteworthy single feature, for the section of the Southern Appalachian Mountains through which the "Crest of the Blue Ridge Highway" will pass contains the loftiest peaks east of the Rocky Mountains, with mountain slopes covered with a more varied fauna and flora than is found in any other section of this country.

The grandeur of the scenery along this highway, comprising, as it will, extensive vistas into the Piedmont region, nearer views of valleys, and mountain tops, and ridges, with here and there a most attractive waterfall; and the highway crossing and passing streams of clear crystal water and penetrating the dense evergreen forests of balsam and spruce, whose deep shade always casts a feeling of awe over the traveler as he passes through them, will make the ride over this highway one never to be forgotten.

Several articles have been written and widely circulated regarding this highway. One, which appeared in the *American Motorist*,\* is quoted in part as follows:

When the plan for the Crest of the Blue Ridge Highway has been worked out in its entirety it will extend from Marion, Virginia, to Tallulah Falls, Georgia. At the former place it will make connection with the Bristol-Washington Highway and at Tallulah Falls will connect with a good road leading to Atlanta, Georgia. Although only occasional portions of this road have been thus far constructed, yet it is thought that a description of the road, with views that will be seen from the highway, would be of interest. From Marion, Virginia, the highway will pass close to Whitetop Mountain, which is a celebrated mountain resort region in southwest Virginia, and is adjacent

\*Highways of North Carolina, by Joseph Hyde Pratt; *American Motorist*, April, 1912, pp. 265-272.



to the Norfolk and Western Railway. The route is then through Ashe County, North Carolina, via Beaver Creek and Elk Cross Roads to Boone, Watauga County. There is an ordinary country road connecting Marion via White Top with Boone, but a considerable portion of the road will have to be relocated and all the road surfaced. This link comprises possibly 75 miles. From Boone to Linville, a distance of 32 miles, the road is well graded and open for automobile traffic. The route is via Blowing Rock, a noted resort of this section of the Southern Appalachian region, at an altitude of about 3,600 feet. The views from this ridge into the deep valley on the headwaters of Johns River are equal to, though very different from, the views into the canyons of the mountains of western United States. From Blowing Rock to Linville the route is over the celebrated Yonahlossee Road. This road was the first good road built in the mountains of North Carolina and was constructed by Kelsey. A graded road, 22 miles long, connects Blowing Rock with Lenoir, Caldwell County. Linville is a unique mountain resort in the upper valley of the Linville River, which combines a most delightfully cool summer climate with 70 odd miles of stream trout fishing, a large lake for lake fishing, and a golf course of considerable renown. Esseola inn and cottages are equal to any in the Southern Appalachian Mountains. From Linville to within a few miles of Linville Falls the road is now partly completed and can be used by automobiles, although there has been no surfacing material used on the road and it gets very heavy in wet weather. The road passes Altamont, Grassland, and Pineola. At Pineola and Linville Falls there are well-equipped inns that are open for the accommodation of tourists during the summer season. At Linville Falls the tourists will find the Linville gorge and valleys a most attractive place to visit.

From Linville Falls to Asheville, a distance of approximately 96 miles, the route is through an entirely new country through which no road had been thought of until the "Crest of the Blue Ridge Highway" was advocated. From Linville Falls to Altapass, a station on the Clinchfield Railway, the highway will be an entirely new one and follows very close to the summit of the Blue Ridge, and will open up to the traveler some beautiful scenes in the Piedmont valley via Brushy Creek Gap, Humpback Mountains, Hog Gap and Rose Creek Ridge and McKinney Gap, which is within 2 miles of Altapass, the highest point on the Carolina, Clinchfield and Ohio Railway. Leaving McKinney Gap, the highway will follow on the southern and eastern side of the Blue Ridge to Gillespie Gap, from which point there is a good road to Little Switzerland, a new resort that has been started within the past few years. Leaving Little Switzerland, the highway will pass through Bear Wallow Gap, Gooch Gap, and then cross ridges and around peaks to Blue Ridge Meadows, and then practically with the crest of the ridge to Buck Creek Gap. From Buck Creek the highway is via Toe River Gap and Stepps Gap, the latter being the highest point of the highway, where it reaches an altitude of approximately 5,500 feet, being within 1,200 feet of the top of Mount Mitchell, the highest mountain east of the Rockies, with an elevation of 6,711 feet. At Stepps Gap the highway will be in the heart of the Black Mountains, and from there to Bull's Gap, a distance of 26 miles, the highway crosses some of the most rugged mountains in the whole region. The highway passes around Mount Gibbs, Clingmans Peak, Potato Knob, and along the east side of Black Stock



Knob. Here, for some distance, Mount Mitchell and the other peaks of the Black Mountains are in full view. From Black Stock to Balsam Gap, which represents the end of the Black Mountain range, the highway is along a ridge which is the dividing line between the Asheville watershed on the west, which contains an area of approximately 10,000 acres, and the celebrated Murchison boundary on the east, which contains 13,000 acres of magnificent virgin forest. From Balsam Gap the road follows Peach Orchard Ridge, climbing up to the summit of Bull Head Ridge, an elevation of 700 feet. There is then an easy grade down to the gap between the Dome and Bull Head, and thence on the southwest side of Craggy Pinnacle through Craggy Gap and to Craggy Fields, which has already been used a great deal by camping parties and is a magnificent site for a hotel. From Craggy Fields the highway will follow on the western side of Craggy Knob, through Carter's field, along the south side of Snow Ball Mountain to Potato Gap. Then, crossing ridges, and passing in and out of coves, the highway passes on the west and north sides of Lane's Pinnacle, Courthouse Knob, and Richland Knob to Bull Gap. A short distance out of Bull Gap is Rattlesnake Lodge, the summer home of Dr. C. P. Ambler of Asheville. From Bull Gap to Sunset Mountain the highway follows an old tramroad which only needs revision for about 2½ miles. From Sunset Mountain to Asheville, a distance of 5 miles, the highway has recently been completed by Mr. E. W. Grove of Asheville and St. Louis. It is of macadam, well graded and its ever-changing views are a constant source of pleasure to the traveler.

From Asheville the "Crest of the Blue Ridge Highway" will be via Hendersonville, to which place, as already stated, the road has been constructed. From Hendersonville to Brevard, a distance of 20 miles, there is a fair country road. Leaving Brevard, Transylvania County, the highway follows up the French Broad Valley and crosses the Blue Ridge to Toxaway Lake, from which place for nearly 10 miles the route of the highway will be through the well-known property of the Toxaway Company, which has been called the Sapphire Country. At Brevard is the Hotel Franklin, and at Toxaway is the Toxaway Inn. The Toxaway country is very picturesque and the three lakes add a great deal to the beauty and grandeur of the scenery. From Lake Toxaway to Highlands the highway passes Lake Sapphire and Fairfield Lake, through Cashiers Valley around Whiteside Mountain to Highlands, the highest town in the State. Plans are now on foot to open up a first-class automobile road from Asheville to Toxaway Lake which will then open up to the automobilist perhaps the most attractive mountain resort in the Southern Appalachian region. The management of the Toxaway property will also continue the good road around Lake Toxaway, a distance of 15 or 20 miles, and through the property around the other lakes, and meet the road from Cashiers Valley.

From Highlands to Tallulah Falls, a distance of about 30 miles, the road will have to be entirely relocated.

While the "Crest of the Blue Ridge Highway" seems to be somewhat in the future, it is confidently expected that this road will be completed and open for travel within a very few years, and in the course of its construction it is expected that as mile after mile is completed it will be open for travel. Although this highway passes through the most rugged section of the Southern Appalachian Mountains and crosses many mountain ridges, the grades will all be under 5 per cent.



Another article on this same highway was published by Prof. T. F. Hickerson in *Southern Good Roads*.<sup>\*</sup> The following excerpt is taken from this article:

The scheme for a scenic highway and a chain of hotels through the mountains of western North Carolina, where the scenery is considered by many to be the equal of any in the world, was thought out and put into effect through the efforts and influence of Dr. Joseph Hyde Pratt, State Geologist. The proposed location of this highway extends from Asheville to Boone, but the ultimate plan is to extend it from Boone northward by Whitetop Mountain to Marion, Virginia, in order to connect with the Bristol-Washington Highway which passes by Roanoke and through the Shenandoah Valley, and from Asheville southward by way of Hendersonville, Brevard, Toxaway, Highlands, Tallulah Falls, Ga., Cornelia, Ga., to a point on the National Highway, and from there to Atlanta. See map, Fig. 5.

There will be approximately 353 miles of the highway between Marion, Va., and Cornelia, Ga., nearly all of which lies in North Carolina. The following table gives the portions which are already graded and constructed, etc.:

Marion, Va., to Boone, N. C., 75 miles, no part of it constructed.

Boone to Asheville, 134 miles, 52 miles constructed.

Asheville to Toxaway, 64 miles, 64 miles constructed.

Toxaway to Highlands, 28 miles, 28 miles constructed.

Highlands to Tallulah Falls, Ga., 30 miles, no part of it constructed.

The total distance is 353 miles and 144 miles of the road have already been built.

The total length of the highway from Boone to Asheville, the part with which this article deals, will be about 134 miles. Several sections have already been constructed, namely:

Boone to Blowing Rock.....	10 miles
Blowing Rock to Linville (Yonahlossee Road).....	22 miles
Brushy Creek Gap.....	13 miles
Mount Mitchell Station to Little Switzerland.....	3 miles
Bull Gap to Asheville.....	10 miles

Total .....	58 miles
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About six miles of the road between Linville and Brushy Creek Gap needs to be revised; hence the total length of road to be constructed equals 82 miles.

Sixteen weeks of the last two summers have been spent in making a survey of the territory between Linville and Asheville. The part surveyed during ten weeks of the summer of 1910 under the auspices of the North Carolina Geological and Economic Survey extends from Linville to Buck Creek Gap. There were ten men in the party besides the cook and camp boy; the chief engineer was Mr. W. L. Spoon, who was then State Highway Engineer. The other members of the party were: T. F. Hickerson, transitman; J. M. Costner, levelman; N. C. Hughes, levelman; R. T. Brown, front rodman and chainman; M. C. Lasitter, rodman; J. F. Speight, stakeman; P. M. Smith, level

<sup>\*</sup>Crest of the Blue Ridge Highway, by T. F. Hickerson, *Southern Good Roads*, February, 1912, pp. 5-12.



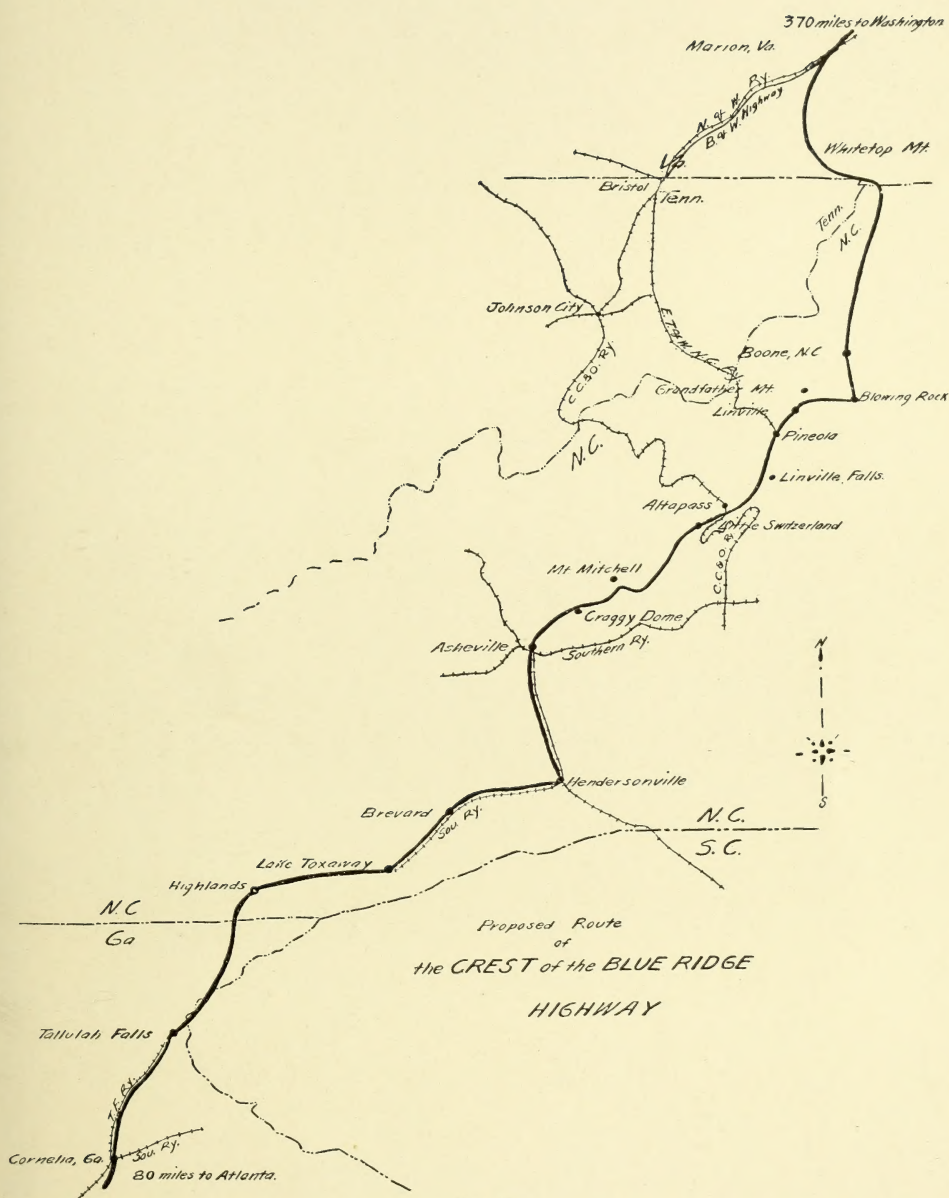


FIG. 5.





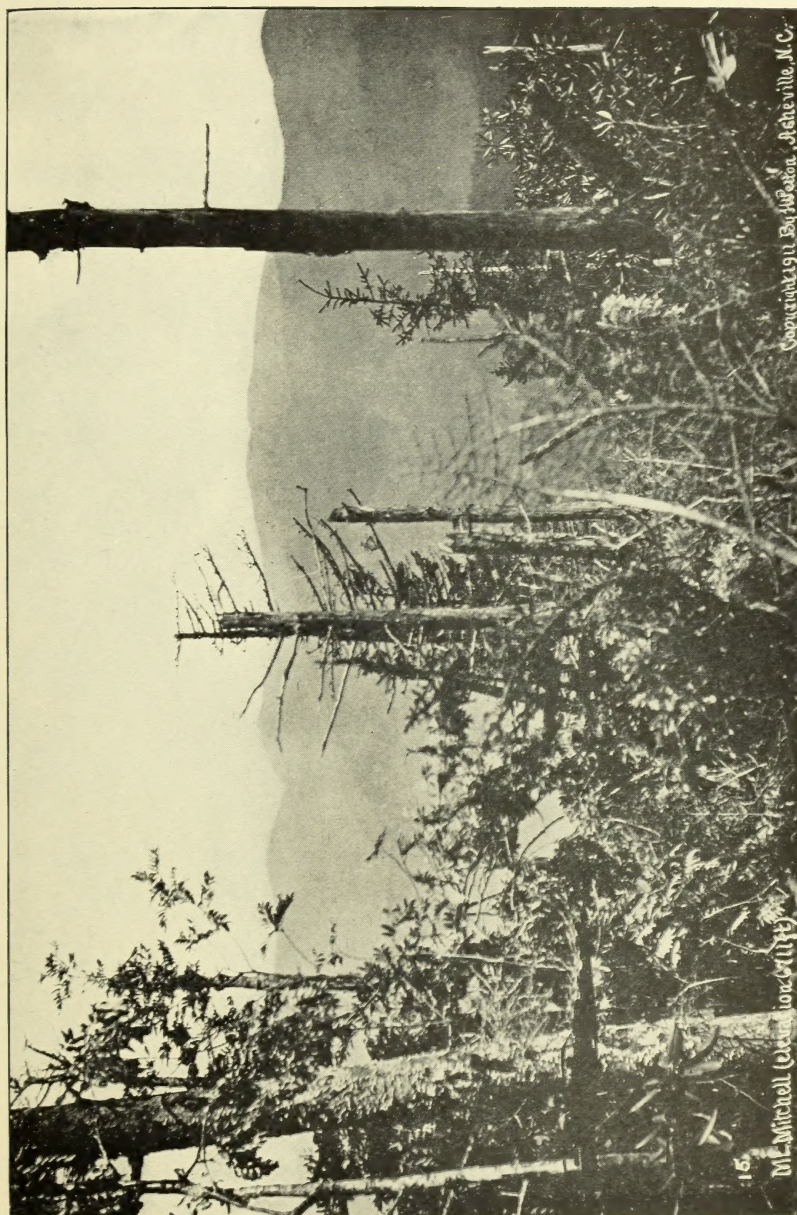


FIG. 6.—Mount Mitchell, elevation 6,711 feet. Crest of Blue Ridge Highway.

Copyright 1911 by Weston, Asheville, N.C.

McMitchell (elevation 6,711 ft.)





rodman; Alex. Feild, chainman; C. C. Brown, rodman. All of the party were University of North Carolina men except Lasitter and Speight, who were C. E. graduates of the North Carolina A. and M. College. The party lived eight weeks in tents and two weeks in boarding-houses. The two camp sites were near wagon roads and only a few miles from the C. C. and O. Railway, so that supplies were easily obtainable.

The survey during six weeks of the summer of 1911, under the auspices of the Appalachian Highway Company, of which Dr. J. H. Pratt is president, starts at Bull Gap (a deep gap 10 miles east of Asheville and 2 miles from Rattlesnake Lodge, Dr. C. P. Ambler's summer home, where the party spent ten days very pleasantly) and extends to Stepps Gap, near Mount Mitchell. There were eight in the party in addition to the cook and camp boy, as follows: T. F. Hickerson, chief engineer; R. T. Brown, transitman; R. M. Smith, levelman; N. S. Mullican, rodman; S. E. Barbour, front rodman; George Strong, level rodman; Arthur Ambler, stakeman; McKinley Pritchard, chainman. All the members of the party were from the University of North Carolina except the last two mentioned. This section of the mountains, embracing a portion of "Craggy" and the "Blacks," averages about 5,000 feet in elevation and is wild, rough, and inaccessible. There were no wagon roads and scarcely any trails that could be traveled in safety with a horse. Moving from place to place the camp equipment, consisting of seven tents, ten folding cots, clothes and two double blankets for each person, a stove, cooking vessels, tableware, rations, and numerous other things, was a problem of transportation more difficult than any of the party had ever met before, since everything had to be packed on mules or portaged a distance of about 7 miles over steep and rough trails. There were three camps; the first at Carter's Field near Craggy, the second at Balsam Gap, the third at Toe River Gap.

This party also had in charge the location and construction of a horseback trail from Bull Gap to Stepps Gap. It follows fairly closely the site of the highway, but for the most part lies nearer the summit of the ridges and peaks. Mr. William Palmer and his party built this trail 2 feet wide at a price of \$50 per mile.

Since the highway is to be primarily a scenic road for tourists, it was located as near the summit of the mountains as the maximum allowable grade, directness, and feasibility of construction would permit. No grades will exceed  $4\frac{1}{2}$  per cent (which means  $4\frac{1}{2}$  per 100 feet or 238 feet per mile). The width of the road will be at least 20 feet. The surface will be of earth or gravel or macadam, the last being necessary at some places on account of the scarcity of dirt and the abundance of loose rock. Much of the located route lies on the north side of the mountain because it was found that there is less declivity and far less rock on northern than on southern exposures to the sun.

The instruments used in making the survey were as follows: aneroid barometer, pedometer, Abney hand level, Gurley transit, and engineer's level. Topographic maps made by the United States Geological Survey were very useful as a guide.

The first step in the preliminary survey was a walking trip over a few miles of the territory for the purpose of getting a clear idea of the topography with reference to the selection of the best route. Barometer readings were taken

at controlling points, such as low gaps and summits of ridges where the scenery is especially good. Hand level readings were taken here and there to determine roughly the grades to various points. The next step was the exact location, by means of the hand level, of the route outlined during the reconnaissance. It often happened that several trial lines had to be run before the most feasible route could be determined. Huge solid rock cliffs with almost vertical faces were often encountered. This necessitated either a raising or lowering of the grade line in order to dodge them. Fortunately, this was done in every case without exceeding a  $4\frac{1}{2}$  per cent grade. In several places narrow ledges of solid rock cannot be avoided and considerable blasting will be necessary for short distances.

Loops were resorted to as seldom as possible and were always located so that the turn was made on comparatively flat ground where excessive excavation would not be required. In about a dozen places between Linville and Asheville loops were introduced to reach a low gap, or cross a ridge, or surmount a rock precipice.

When the most suitable route was finally established after due consideration had been given to directness, economy of construction, and scenic advantages, the transit, level, and cross-section parties came along with two or three axemen and made an accurate instrumental survey of the located line, so that a map showing the plan, longitudinal profile, and transverse profiles at intervals of 100 feet can be drawn, from which an estimate of the cost can be made. Notes were made of stream crossings, property, character of the soil, amount of rock, extent of forest and open ground, and all points of interest.

The average grade along the whole location is about 4 per cent. This means that there are practically no level grades. If two gaps, 1 mile apart, had the same elevation it would make the route more direct in most places to run up on 4 per cent halfway and down on 4 per cent halfway, instead of running on a level the whole distance, on account of the fact that the spur ridges and coves are much wider and deeper lower down on the mountain.

The maximum and the average altitudes of the various sections of the highway between Boone and Asheville are as given below:

Boone to Blowing Rock, 10 miles, maximum elevation 3,500 feet, average 3,360 feet.

Blowing Rock to Linville, 22 miles, maximum elevation 4,000 feet, average 3,800 feet.

Linville to Altapass, 25.5 miles, maximum elevation 4,100 feet, average 3,700 feet.

Altapass to Little Switzerland, 6.5 miles, maximum elevation 3,300 feet, average 3,000 feet.

Little Switzerland to Buck Creek Gap, 12.5 miles, maximum elevation 3,800 feet, average 3,500.

Buck Creek to Stepps Gap, 22 miles, maximum 5,200 feet, average 4,500.

Craggy Fields to Asheville, 22.5 miles, maximum elevation 5,500 feet, average 3,500 feet.

The location from Asheville to Boone in detail is as follows: Beginning at Asheville, the proposed highway coincides with the road to the top of Sunset Mountain, for a distance of 5 miles. A detailed description of this road, as seen in *The Manufacturer's Record*, October 26, 1911, is as follows: "An



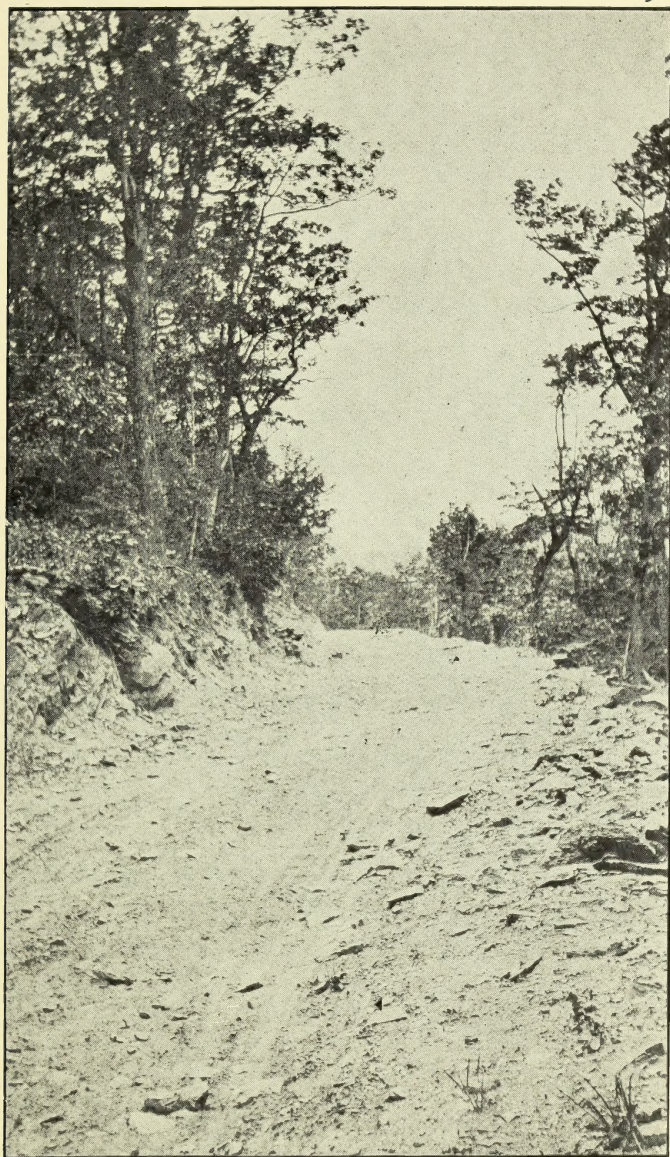


FIG. 7.—Around the mountain near Switzerland Inn.  
Crest of the Blue Ridge Highway.





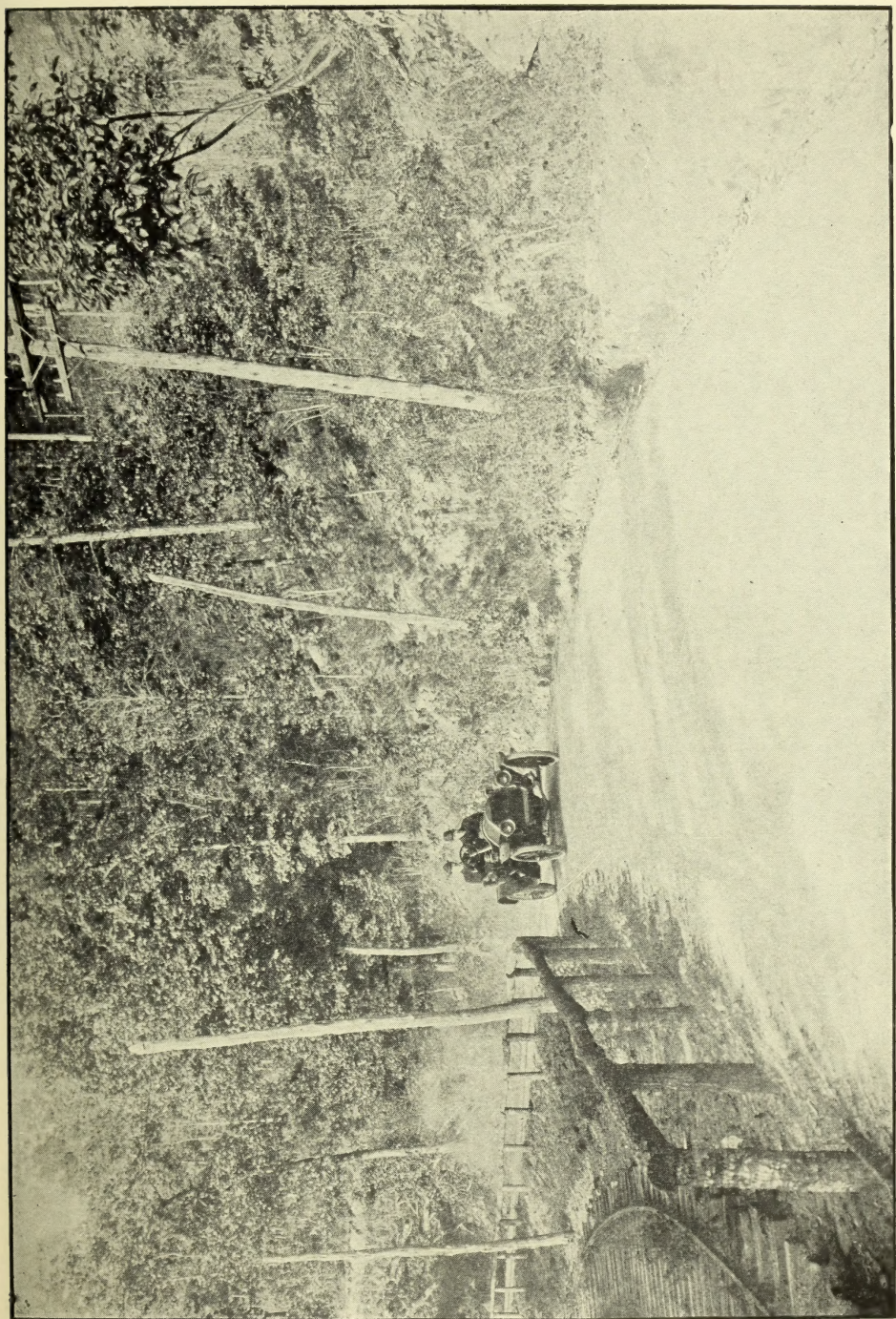


FIG. 8.—On the Crest of the Blue Ridge Highway. The Grove Road, up the mountain east of Asheville, N. C.





exclusive automobile road, Fig. 8, nearly all of which is 3 per cent grade, with none greater than 5 per cent, beginning at the foot of Sunset Mountain, near the end of Charlotte Street, Asheville, and winding around the face of the mountain to its summit, has just been opened to the public by Dr. E. W. Grove of Asheville and St. Louis. The entire length of the road to the summit has been laid with macadam. There are signs at approaches to all curves to 'Blow Horn,' while at its intersection with the carriage road that also leads to the summit are signs giving notice that carriages are not allowed on this road. The carriage road over a different course also has signs advising the public that automobiles are not allowed on it. The distance from the center of the city to the summit of Sunset Mountain over this road is 5 miles, and motoring over its smooth surface presents to the eye views of rare sublimity and grandeur. The consummation of the tourist's enjoyment is attained when the summit of the mountain is reached. Here, at an altitude of 3,119 feet above sea level and nearly 1,000 feet above the city, is a spread of vernal beauty that encompasses rare delights of valleys and summits, and in the full look across the Asheville plateau there is a world of grandeur and a loveliness of setting that stretches away to the far-off mountains in the west, where the majestic peaks of Pisgah, Richland, Balsam, Cold Mountain, and the Bald pierce the sky at altitudes of 5,749, 6,540, 6,000, 5,400 feet, respectively, with a dozen others ranging in height 3,100 to 5,000 feet. This automobile road connects at the summit of Sunset with the Crest of the Blue Ridge Highway, which is to extend from Asheville to Blowing Rock, along the crest of the mountains, at elevations ranging from 3,100 to 6,200 feet above sea level."

The section of this highway between Altapass and Linville, N. C., is now being built under the supervision of Joseph Hyde Pratt, engineer.

#### TRIANGULAR HIGHWAY.

This highway, which is being very strenuously advocated by many along this route, is to extend from Pinehurst to Raleigh, Raleigh to Greensboro, Greensboro to Pinehurst. This road has been surveyed, and committees are at work providing ways and means for the construction of the three sides of the triangle. The side from Raleigh to Pinehurst follows the same route as the Capital Highway; the side from Raleigh to Greensboro is part of the Central Highway, and the side from Greensboro to Pinehurst is via High Point, Asheboro, Biscoe, and Eagle Springs.

#### OTHER HIGHWAYS.

Another highway which passes through North Carolina is the Capital Highway, which is planned to connect Washington with the southern capitals. It passes through North Carolina via Roanoke Rapids, Halifax County; Warren Plains, Warren County; Henderson, Vance County; Franklinton and Youngsville, Franklin County; Wake Forest, Raleigh, and Fuquay Springs, Wake County; Duke, Harnett



County; Fayetteville, Cumberland County; Raeford, Hoke County; Southern Pines and Pinehurst, Moore County; and Ellerbe and Rockingham, Richmond County. As Lee County has recently voted \$100,000 for good road work in that county, it will open another road from Southern Pines to Raleigh via Jonesboro and Sanford, Lee County, and Apex and Cary, Wake County. The southern end of this Capital Highway from the South Carolina line to Hoke County is a good sand-clay road, but from this point to the Virginia line, with the exception of the first-class sand-clay roads of Franklinton Township, Franklin County, there are only a few stretches of good roads in the whole distance except through the very dry weather.

The National Highway crosses North Carolina in the Piedmont section via Stoneville and Madison, Rockingham County; Stokesdale, and Greensboro, Guilford County. From the latter city the National Highway is coexistent with the Central Highway, which has already been described, as far as Landis, Rowan County. Another prong of the National Highway is from Stokesdale, Guilford County, to Winston-Salem, Forsyth County, and thence to Lexington, Davidson County, where it encounters the Central Highway. From Landis the National Highway is via Concord, Cabarrus County; Newell and Charlotte, Mecklenburg County; Gastonia and Bessemer City, Gaston County; and Kings Mountain and Grover, Cleveland County. The northern portion of the National Highway in North Carolina in Rockingham County is a fair-weather road and in wet weather is very heavy and sometimes becomes almost impassable for automobiles. Rockingham County, however, is arranging to put the road in good condition and in a short time this portion of the National Highway will be a good road. From Landis south, with the exception of a few miles of poor road in Cabarrus County, this highway is a good road.

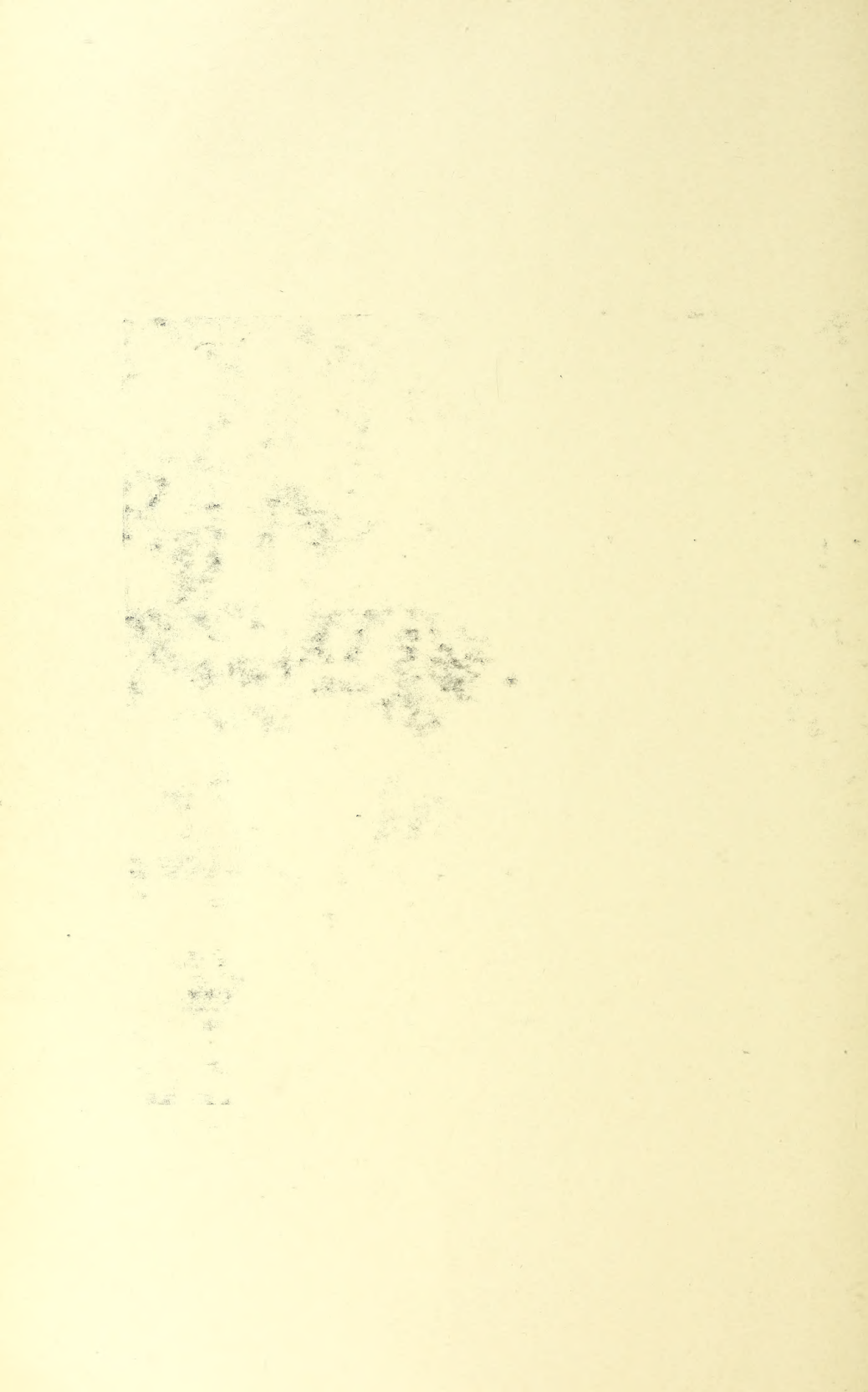
#### KINDS OF ROADS CONSTRUCTED IN NORTH CAROLINA.

The comparatively recent movement for better roads in North Carolina may be said to have been inaugurated by the passage of what is known as the Mecklenburg Road Law a decade and a half ago. During that time the kinds of roads which the more progressive counties attempted to build were, first and primarily, the macadam, and, second, the sand-clay and gravel. Because of the great expense of building and maintaining the macadam, it has long been felt by those who were interested in this phase of industrial development in North Carolina that there must be some cheaper road which would answer the requirements of the greater part of the mileage of public roads in the State.





FIG. 9.—Sand-Clay Road near Franklinton, Franklin County, on Capital Highway.





## SAND-CLAY ROAD.

This need has been met to a great extent by what is known as the sand-clay road, and, in connection with the collection of the data of this report, letters have been written to different counties which have built sand-clay roads to ascertain how this road stood up during the winter of 1911-12, which has been an exceptional one in point of freezes, rainfall, and other agencies which cause roads to deteriorate. Below is given some of the replies received from men who have been interested in the construction of the sand-clay road and also some quotations from the press with regard to the condition of the sand-clay roads constructed in their vicinity.

Mr. W. L. Spoon, Highway Engineer for Forsyth County, writes:

"My sand-clay work has stood remarkably well. Very little of it failed, notwithstanding it was constructed last fall in very dry weather. I am hopeful for this class of road for much of Forsyth County."

Mr. P. B. Beard, Chairman of the Board of County Commissioners of Rowan County, writes as follows:

"I dislike to acknowledge the fact that my sand-clay roads have not had the attention they deserve and their condition should not be used as a criterion. I very much believe they are the road to be used generally in this State."

A letter from Mr. W. S. Fallis, who built the sand-clay roads in Franklinton Township, Franklin County, reads as follows:

"I have just finished making some inspection and inquiry and feel pretty sure that every part of the roads here (Franklinton) that did not need repair work when the winter began is now in perfect condition. The places where work should have been done in the fall suffered very much on account of the winter weather and will need more work on that account than would otherwise have been needed. The entire mileage of Franklinton Township can now be put in perfect condition for less than \$500, showing that the class of work done here will be entirely successful under any conditions that can affect the work."

Mr. J. A. Davidson, Road Commissioner of Guilford County, writes in regard to some sand-clay construction which was done in Guilford County, as follows:

"We have done but little road construction on account of the extreme bad weather, but what sand-clay road we have put down is standing up well, and I am satisfied it is decidedly the most practical road we can build."

Mr. W. G. Buie, Chairman of the Board of County Commissioners of Scotland County, writes in regard to sand-clay roads in his section as follows:

"Our sand-clay road did not stand up well during the bad weather this winter. It looks to me as though our roads would stand up better if they had less clay and more sand in the mixture. Our roads keep in fine shape in dry weather, but when we have much rain and freezes the clay gets sticky and cuts up in holes and ruts."

Undoubtedly, the reason why the Scotland County sand-clay roads did not stand up better during the past winter is that too much clay was used in their construction, and they have, therefore, an excessive amount of clay, which is bound to get muddy and cause the roads to cut up during the winter. By adding more sand to these roads they can be brought into first-class condition.

Mr. H. B. Allen, Chairman of the Board of County Commissioners of Anson County, says:

"Our sand-clay roads have stood up as well as could be expected with so much rain and travel on them. It seems a little hard with our inexperience to get the proper proportion of sand and clay. . . . I think with one or two draggings of our sand-clay road we would have a good road."

Mr. W. E. Jeffrey, Chairman of the Rocky Mount Road Commission in Nash County, writes:

"Answering yours as to how the sand-clay roads in Nash County have stood up during this winter, I beg to say that a large majority of them have gone to pieces owing to the fact that sub-clays were used in separate bottom layers. In many places the sand applied on top was not sharp or clean and no harrowing or puddling was done, leaving the mixing to be done by travel in bad weather, which has been pretty thoroughly done. Should there have been enough of the proper kind of sand used, after the thorough mixing they have had, when worked and dragged we would have had a great deal better system of roads than we have. However, we have some very fine clay and sand roads, which have stood under the heaviest traffic in the county. These pieces of road were built from sharp, coarse sand, naturally having the right proportion of clay mixed with them before it was applied to the roads.

"From my experience I find that it is impossible to build sand and clay roads that will stand up in bad weather under heavy traffic unless you get sharp sand with the proper amount of clay wrapped about each grain, or using the proper amount as above stated, mixing same by travel in bad weather or by puddling process, either of which requires a great deal of work in time before the road is finished and becomes permanent."

Mr. H. S. Bunn, Clerk to the Board of County Commissioners of Edgecombe County, writes:

"Where the work was properly done the sand-clay roads are very satisfactory."



Judge A. W. Graham of Granville County writes in regard to the sand-clay roads:

"As you know, in the central and northern portions of the county it is difficult to find the kind or quantity of sand, gravel, or soil to make first-class roads, and consequently the covering of the roads was not thick enough and in many places the vehicles broke through to the clay and the roads became very bad. But in the southern part of the county wherever the sand was put on thick enough and the roads were properly drained, the result has been very gratifying. You know the roads through the 'Black Lands' of Dutchville Township were the *bête noire* of travelers, but wherever they were properly sanded and drained they have proven the best in the county. The commissioners used the split-log drag in the months of February and March (1912) and the results were very encouraging. Part of the time the 'dragged' roads were as good as you ever saw them in July and August. They were used sufficiently to demonstrate the fact that if the roads are drained and sanded, or soiled, to a depth of 7 to 9 inches the cost of maintenance will be insignificant, for two drags with four mules to each will work up 10 miles per day.

"Given proper grading, drainage, and sanding or soiling to a sufficient depth, the split-log drag or King drag will solve the problem of road maintenance in this section of the State. But no county will ever be successful with its roads without a competent road engineer for superintendent."

Mr. W. J. Olive, Chairman of the Board of County Commissioners of Cumberland County, writes:

"Our roads are in bad shape. Most of them where there is *plenty of sand mixed with the clay have held up O. K.* We have made mistakes in building our roads in not mixing enough sand. Where the clay is close and sticky, it ought to be at least one-half sand mixed in with the clay. If properly mixed and worked together, the sand-clay roads are a success."

Mr. G. D. Canfield, one of the trustees of the Central Highway Committee of Carteret County, writes:

"We regret to say that we used entirely too much clay on our roads. While part of it stood up in good shape, the most of it rutted up considerably during the extreme rough weather."

In an interview with Mr. George Stevens, President of the Kanuga Club in Henderson County, Mr. Stevens stated in regard to the sand-clay road which he has built from Hendersonville to the Kanuga Club, "that that form of thoroughfare is preëminently suited for this section of the State; that it stood the wear and tear of automobile use much better than macadam road and is much cheaper to build and maintain."

"In rainy seasons," Mr. Stevens remarks, "the sand-clay road is the only one which stands hard usage well."

The *Asheville Gazette-News* of March 21, 1912, states the following:

"The road problem for most sections of Buncombe County seems to have been solved.

"The Beaverdam Valley sand-clay road, the first built in this part of the State, has passed through the winter—severest season of test for a highway in the memory of most of the people—practically as good as it was when winter began. The first quarter-mile section of this road has now stood two winters and one summer. It has been a good road every minute of the time since it was first packed.

"The first section was made in December, 1910. The second section of about 2 miles was made the January and February following. This road was graded by convict labor. It was then surfaced by the people of the neighborhood under the direction of the county engineer.

"In general, the formula of the Beaverdam road is as follows: 6 inches of sand and upon that a layer of clay, 3 inches deep; on that 4 inches of sand; the whole finished with 1 inch of clay or gravel. The gravel finish proved somewhat the better. On the original quarter mile there was about 4 inches of sand with no clay added and no gravel.

"There was originally a theory that a sand-clay road should be a very bad road the first winter after it is made. This has not been the case with this road. . . . The road is of consistent goodness now from one end to the other. It has endured much heavy hauling since the time it was completed and was badly cut up by teams in the process of settling and forming.

"The road has never been dusty to speak of, even in dry autumn weather when the macadam was blowing away."

The first part of this sand-clay road was built under the supervision of the North Carolina Geological and Economic Survey and was an experiment to demonstrate the value of the sand-clay road in the mountain region of the State. Its success has meant the construction of this type of road in nearly all the counties of western North Carolina where suitable sand and clay can be found.

Mr. Wolfe, Supervisor of Roads, says: "The road has not had the attention it should have had. Proper attention and the road drag would cost about \$3 per mile per year. There is no indication that with such care this highway ever would wear out."

Mr. Wolfe observes "that the greatest advance in the cause of good roads would be the outlawing of narrow tires. There should be no wagon tires on country roads narrower than 4 inches."

"The sand-clay road leading from Grace up Beaverdam Creek is the best road in the county to-day," said County Engineer J. C. M. Valentine, in a general conversation about the condition of the roads in the bad weather, in which he went on to say that these roads had stood the deep freezing much better than the macadam roads. Mr. Valentine stated: "Even the roads on the Biltmore Estate, which are conceded



to be the best of macadam, had suffered much by reason of the freezing, but so far as can be told the sand-clay roads have not been affected very much by the cold."

From the above testimony it will be seen that sand-clay roads which have been properly constructed in the various sections of North Carolina have met the most adverse conditions and proven their worth.

In constructing the macadam road the county officials usually let it by contract, so that the work is done by experts; but in building the sand-clay road the idea is more prevalent that it can be constructed to advantage by county road officials. In most instances these officials are not expert road builders, and it would be better if the county or township would employ a competent road engineer for the construction of these roads; but untrained men can learn the mechanics of sand-clay road building and it is thought that it would be of service to such men to have the general directions for building sand-clay roads. For this reason this is included in this report.

#### CONSTRUCTION OF THE SAND-CLAY ROAD.

##### QUALITY OF THE SAND AND THE CLAY.

Before beginning the construction of a sand-clay road, the sand and clay in the vicinity of the road should be examined to ascertain whether they have the right properties necessary to build a first-class sand-clay road. The best sand or gravel to use is that which has a sharp cutting edge and it should not be in too fine grains. A clean, sharp grit such as is desired in making mortar is the quality of sand that is wanted. The best results are obtained, however, when the grains of sand are coarser than those used in making mortar. While any clean sand will make a good sand-clay road, the sharper the grit the better the resulting road. The characteristics which are most desirable in the clay are plasticity and the ability to slake well when it first becomes wet. A clay is called plastic when it becomes sticky or dough-like when mixed with a certain amount of water, so that it can be molded or pressed into various shapes which it will retain even after it has been dried. If a lump of such clay is put in water, it will usually retain its form for a long time. There are other clays, however, which will immediately fall to pieces when placed in water as a lump of quicklime will do under similar conditions. This is due to the very rapid absorption of water into the porous construction of the clay. It can readily be seen that this characteristic is an important one when considering the material to be used in a sand-clay road.

There is still another physical characteristic of clay which is to be considered from the standpoint of the road builder. Some clays shrink

when dried, which is shown by the cracking and breaking out of their surfaces. This shrinkage is the measure of their expansion, and expansion makes a sand-clay composition unstable. Shrinkage would do no harm if the clay would stay in this condition, but it does not. When water, removed by evaporation, is restored to the sand-clay mixture, its entrance is accompanied by a simultaneous expansion which causes the grains of sand to become separated. This property cannot be overcome, for it is inherent in the clay, but we can in some measure modify this fact by using less clay in the composition. This, however, will weaken the road and cause it to break up in dry weather. Avoid such clays if possible.

One good test for a clay is to wet the thumb and place it against the clay, and if it sticks to the thumb it is of the right quality for making a sand-clay road. If, on the other hand, it does not stick to the thumb, we are safe in assuming that this particular clay will not make a good binder. In general, select the stickiest clay and the sharpest sand available.

Occasionally, a natural mixture of sand and clay have been found in the right proportion and of the right quality to make a hard-surfaced road. Where such materials have been found in the fields adjoining the highway and have been used in surfacing it, the mixture has been called "top-soil dressing," and the resultant road a "top-soil" road. In reality, however, it is a sand-clay road and we have simply used a mixture of the sand and clay which nature has provided.

The proportion of sand and clay in the best sand-clay road should be such that there is just a sufficient amount of clay, and no more, to fill the voids between the grains of sand when these grains are touching each other. The clay is the binder that is to hold the grains of sand in place, and there should not be any more than is sufficient for this purpose. In Fig. 10 is an illustration (magnified) of a mass of sand and clay where the grains are touching each other and the voids are exactly filled with clay. If too large a proportion of clay is used, the grains of sand are prevented from touching each other and are able to move about each other in the mass of clay so that the resistance of the mass to the wearing effect of traffic is practically no more than if the road was composed simply of clay. Water is also able to act upon the mass of clay and the road becomes sticky and muddy. In Fig. 11 is illustrated a section of road where there is too large a proportion of clay. If there is too small a proportion of clay used, the grains of sand are not cemented tightly together and the road disintegrates very quickly under traffic and rain.



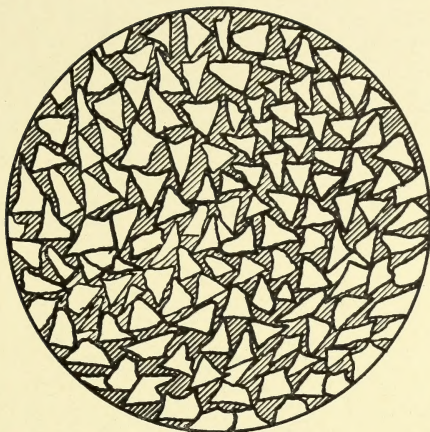


FIG. 10.—Section of sand-clay road showing a complete and thorough mixture of the clay and sand. Just sufficient clay to fill the voids between the grains of sand.

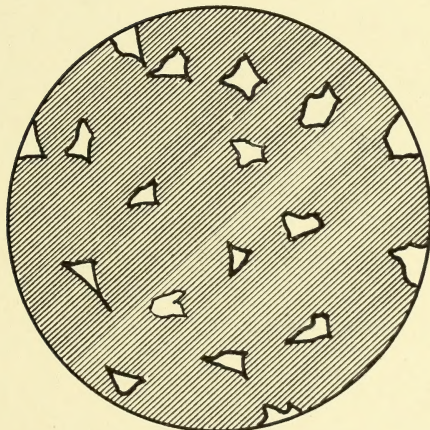


FIG. 11.—Section of road where there is a large excess of clay, which prevents the grains of sand from touching each other.





The exact proportions of sand and clay for making the best sand-clay road cannot be stated, as the proportions vary with the character of the sand, according to its sharpness, percentage of foreign material, and size of grains. Approximately there is in a sand-clay road about 80 per cent sand and 20 per cent clay. One simple means of determining the theoretical amount of pure clay that should be added to any sand that is to be used in the construction of a sand-clay road is to fill a glass tumbler brimful with the sand that is to be used and then fill a similar tumbler with water; pour the water carefully onto the sand until the water comes flush with the surface, which will mean that all the voids between the grains of sand are now filled with water. The amount of water that has been poured into the tumbler containing the sand will represent the proportion by volume of clay that it is necessary to add to that particular sand to fill all the voids with clay.

#### METHOD OF MIXING SAND AND CLAY.

Having determined the source of supply of the best materials for making a sand-clay road, the next question is the mixing of the materials, and this varies with the character of the subsoil, whether this be a sand upon which clay is to be added or clay upon which sand is to be added. It will be found that it is much easier to make a sandy-clay road where the subsoil is a clay.

*Clay Subsoil.*—The road should be properly located and graded and then the surface of the road shaped with the proper crown and slope from this to the ditches. The surface should be smooth and about 4 or 5 inches lower than what is desired when the road is completed. When this is finished the portion of road that is to be a sand-clay road, either 9 or 16 feet in the center, should, when perfectly dry, be plowed to a depth of 4 inches and thoroughly harrowed with a cutaway (disc) harrow. The sand should then be spread over the surface to a depth of 4 inches and thoroughly harrowed in and then 4 more inches of sand spread over the surface, and again thoroughly harrowed. After this mixing of the sand and clay is completed, the road should be dragged, and after the first heavy rain the road should again be harrowed and then dragged into shape so as to give it the proper crown. It will then become a firm, hard-surfaced road. If a roller is convenient, this may be used to some advantage.

If the sand-clay road is constructed as outlined above and good clean, sharp sand is used on a plastic clay, a first-class sand-clay road will be the result.

In too many instances in constructing a sand-clay road the sand has simply been spread over the clay, and it has been left for teams to mix

it in with the clay. This takes a long time and very often there is not a thorough mixing of the two materials, so that the resultant road is not always uniform in its construction and does not give as good satisfaction as when constructed by the method described above.

If the sand is added to the clay road when it is wet, the harrowing can all be done at one time, and, when shaped up and dried out, it becomes a hard-surfaced road. The main objections to making the sand-clay road in this way are, that unless the clay road is extremely muddy and wet the harrowing of the sand into the clay causes considerable of the clay to get into round balls, which are not broken up by the harrowing; and that there is not as even a mixing of the sand and the clay as when they are thoroughly mixed dry and then harrowed later when they are wet.

*Sand Subsoil.*—If in making the sand-clay road we start with a sand subsoil and have to add clay to this, the method of procedure is somewhat different from the case outlined above. The sandy roadbed should be left flat and then a layer of clay spread over it to a thickness of 4 to 6 inches, according to the quality of the clay and the amount of sand which it contains. If it is a very pure, plastic clay, it will take a much smaller amount than if it is a very lean or sandy clay. There should then be spread over the clay a layer of clean sand and the road thoroughly harrowed. After this has been accomplished, the road should be brought back into shape and then after a heavy rain again harrowed and shaped up. There is usually a tendency to get too much clay in making a sand-clay road when the sand is the subsoil. If the clay that has been used is a very plastic clay, there is going to be considerable tendency for it to ball and cake, so that a plow can very often be used to advantage in breaking up the lumps. If, however, the mixing is made when everything is perfectly dry, a pretty complete mixture can be obtained by harrowing, unless the clay has been dug when it was wet.

As stated above, it is impossible to determine exactly the proportions of sand and clay to use either in making the sand-clay road on a clay subsoil or on a sand subsoil; and, therefore, as the road dries out and sets, it should have careful attention after it is completed to determine whether it is necessary to add any more sand or clay. If there is too much clay, there will be a tendency for the surface of the road to get sticky or muddy in wet weather and for the clay to ball and cake, and if this is the case a thin layer of sand should be spread over the surface. On the other hand, if the surface of the road loosens in dry weather, it is an indication that the clay that has been used is not a good quality of clay and does not have sufficient binding power. More clay should be added and worked into the road.



Drainage is one of the most essential features in road construction, and it is very true in connection with the construction of the sand-clay road that it shall have good drainage. Where the subsoil is a sandy one, it usually affords a pretty good natural drainage; and where there is considerable depth to the sand, usually the crown of the road is all the drainage that has to be done. It is necessary, however, in all cases that the water be taken out of the side ditches just as rapidly as possible. Where the subsoil is a clay, very careful attention must be given to the question of getting rid of the surface water. Also, in clearing the right of way for the road, all stumps, logs, and other vegetable matter should be taken out of the roadbed, for, if not, after the sand-clay mixture has been made, wherever vegetable matter exists it will as it decomposes make moisture and loosen and soften the sand-clay construction. Proper drainage is, therefore, very essential in the construction of the sand-clay road, and it should be maintained at all times.

#### QUANTITY OF SAND OR CLAY.

The following figures regarding the quantity of clay necessary to add to a sand subsoil to make the sand-clay road, and the amount of sand necessary to add to a clay subsoil, will be of interest:

If the roadbed is 9 feet wide on a sandy subsoil and the clay is added to a depth of 6 inches, it would require 880 cubic yards of clay to cover a mile of road. For a 16-foot road, it would require 1,574 cubic yards of clay. If the clay is a first-class plastic clay, free from sand, and only 4 inches of clay were needed, this would require 587 cubic yards for a mile of 9-foot road, and 1,049 cubic yards for a mile of 16-foot road.

If the roadbed has a clay subsoil, and sand is added to a total depth of 8 inches, it would require 1,173 cubic yards per mile for a 9-foot road, and 2,085 cubic yards for a mile of 16-foot road.

The actual cost of the construction of the sand-clay road for any section can readily be determined by knowing the distance the sand or the clay has to be hauled and the cost of labor and teams per day.

#### SUMMARY.

*Clay Base.*—(1) Have the top of the clay grade smooth and about 4 or 5 inches lower than it will be when finished.

(2) Plow and harrow the top for the width the sand is to be put on, leaving loose but smooth, with no big lumps.

(3) Spread an even layer of sand about 4 inches deep over the top and plow and harrow.

(4) Spread 4 more inches of sand over the top and harrow and drag thoroughly.

(5) Use clean coarse sand, even if it has to be hauled some distance.

(6) When possible, harrow just after a rain.

*Sand Base.*—(1) Smooth the sand road, leaving it perfectly flat.

(2) Spread the clay the desired width and from 4 to 6 inches thick.

(3) If the sand base is clean sand, drag it up on the clay for a thickness of 4 inches, and plow, harrow, and drag thoroughly, preferably after a rain.

(4) If the sand base contains loam, haul clean sand from a pit.

(5) Use natural sand-clay mixture in preference to pure clay.

#### PROGRESS OF ROAD WORK IN NORTH CAROLINA DURING 1911.

During the past two years the North Carolina Geological and Economic Survey has coöperated with the United States Office of Public Roads in collecting monthly data relating to the progress of road work in each county of the State. This work has been greatly facilitated by the most hearty coöperation of the press of the State, who have maintained an exchange with the Geological Survey. In connection with this work also statistics have been collected, the results of which are given in tables given beyond. These statistics show the counties or townships which have issued or sold bonds; the counties and townships which have levied a special tax; those which levy a poll tax; those which have a labor tax; how the money is expended and by whom; the mileage of roads by counties; the number of miles of macadam, sand-clay, gravel, and specially surfaced roads in the counties, and number of miles of unimproved roads in each county; cost per mile of constructing these roads; and statistics relating to the use of convicts on the public roads. These figures are obtained chiefly from county and road commissioners in the different counties.

In considering public road work, either in retrospect, statistically, or suggestions to be made as to work to be done, there are four phases to be considered, namely: financing the proposition; expenditure of the funds; road construction; and road maintenance.

#### METHODS OF FINANCING.

Money is certainly one of the essential features in all public improvements. But little of permanent value has been accomplished in the past in road construction by the irregular, spasmodic, voluntary, and compulsory contributions in the form of labor, teams, implements, materials, etc. No intelligent man now doubts or denies in theory the



fact that every practical system of road building must be based upon money raised by taxation or by a bond issue—the latter, of course, involving the former.

#### DIRECT TAXATION.

If a county or township decides to raise the necessary revenue for good roads construction by a direct tax on the \$100 worth of property, it would require an exceedingly high rate to accomplish the desired results, unless the county contains a large city whose accumulated wealth could be taxed for good road work in the county. The counties having large cities could probably raise revenue sufficient to construct improved roads throughout the county with a tax not running over 50 cents on the \$100 worth of property. For counties, however, without large cities or towns, a special tax for road construction is impractical, because it usually takes a big proportion of the proceeds from the tax to keep the dirt roads which the county already has in a passable condition and leaves very little for construction.

For this reason it has been shown time and time again that the most feasible proposition for the average county is to solve its problem by

#### ISSUING BONDS.

Let us consider briefly what a \$100,000 bond issue would cost a county. In the first place, under normal conditions the bonds can be sold as bearing  $4\frac{1}{2}$  per cent interest. This will mean that the interest on the issue of \$100,000 will be \$4,500 per annum. It will also be necessary to put by a sinking fund to take care of these bonds on maturity. Such a sum as is necessary can be put by each year at 5 per cent interest and at the end of forty years will cover the bond issue. The amount that it will be necessary to put aside each year for this purpose will be \$933; this makes a total of \$5,433 that a county will have to raise each year to take care of this bond issue. This amount will not be as much as it would be necessary to raise by a high tax, 35 to 50 cents, which some counties have levied in providing the money for road construction. Suppose the assessed property valuation is \$8,000,000; a tax of only 20 cents on the \$100 would yield \$16,000 annually, which would be sufficient to pay the interest on the bonds, create a sinking fund, and leave enough money, \$10,500, for the maintenance of the improved roads and to keep in repair the dirt roads of the county which are not being permanently improved.

Many of the counties throughout the South have already issued bonds for the construction of macadam or other forms of improved roads. The result has been that these counties have been more thoroughly developed and become much more prosperous than those which have

been contented with poor roads. The issuing of bonds by a county will mean but a very small increase in taxes, which as the years go by will be more than counterbalanced by the large increase in the value of lands and of other taxable property. It is a fair and equitable arrangement that future generations should pay for a portion of the improvements of our public roads, as they derive as great a benefit from them as the present generation. Too many have an idea that to bond their county will mean a very large increase in their taxes, without their deriving any material benefit from their expenditure, not realizing that the increase in the value of property, and the decrease in the cost of maintenance of the roads, and the wear and tear on horses, wagons and harness, is so much money saved.

The issuing of bonds makes available funds in sufficient quantity to render possible the accomplishment of definite and desirable results.

They give us almost immediately the benefit of good roads, while the payment for them is deferred for many years, until the county has progressed in material wealth to enable it to pay the bonds without unnecessary inconvenience.

They obviate the necessity for a high road tax while accomplishing the results for which such a tax would be levied.

They give us good roads now, and make the best sort of argument for the extension of this progressive movement.

It is a significant fact and one worthy of consideration, that not a single county that has begun the construction of macadam or other improved roads has been willing to call a halt in their construction.

#### OTHER SOURCES OF REVENUE.

Whichever way the county decides it will raise this revenue for good roads purposes, either by bond issue or high tax, it should supplement this by a poll tax of \$1 or more. It seems to me that it is fair and just that every man should pay a tax for good road construction, even if he does not own any property, for the reason that he is directly benefited by the construction of good roads in the county in which he lives, in the uplifted tone of the community, in the general increase in values which has never failed to follow in the wake of public road improvement, in the increase of trade, and in the increase in the demand for labor in both town and country. This, of course, will mean that some will pay both poll and property tax for good roads work, but these could well afford to do so on account of the increased value of their property.

Still another supplementary source of revenue for good roads construction may be had by a State and county by taxing all vehicles that



use the public roads. We have started this movement by placing a special tax on all vehicles using the public road, because all injure the road and increase the cost of its maintenance. A great deal of stress has been laid on the great destruction to a road by the automobile. While this is true, it is not the automobile alone that causes the damage; it is a combination of iron-tired wagons and the automobile. The automobiles alone, run at a moderate speed, would cause but little damage to our public roads; but the cutting and grinding influence of the iron tires and the suction of the tires of the automobile are what cause the great damage when these two classes of vehicles use the same road. As all vehicles are partly responsible for the damage to our public roads, I believe all vehicles using them should be taxed for their maintenance. For vehicles there should be a sliding scale, graduated not only according to the load a wagon will carry, but also graduated according to the kind of tire that the vehicle has; thus, a buggy with rubber tires would be taxed the lowest, while a wagon capable of hauling two or more tons, with a very narrow-tire wheel, will be taxed the highest. Automobiles should be taxed according to their horse-power; as, for instance, \$10 a year for a twenty horse-power machine, and 50 cents per year for each additional horse-power. Of the revenue raised in this way, on automobiles and other vehicles, one-half of the amount should go to the county in which the owner of the vehicle resides, to be used in the maintenance of that county's roads, and the balance to go into the State's road fund for general road work; this tax to be in lieu of any other tax on automobiles or other vehicles that use the public roads. I believe after such a tax had been in force for a short while and our citizens realized that the money thus raised was used for maintaining the public roads, that there would be no complaint whatever against such a tax.

A bond issue supplemented by a poll tax and vehicle tax should give any township or county in the South sufficient funds with which to construct a system of good roads, without working a hardship on any one and at a low rate of taxation.

#### PRESENT METHODS OF FINANCING GOOD ROADS.

In financing road construction in North Carolina, in most instances, the county is taken as a unit, whether the method employed is by bond issue, by special tax, or by the old labor system. In a number of counties, however, where one township has become possessed of a progressive spirit and could not get the others to fall into line, this township has gone forward by itself and issued bonds or levied a tax for better roads.

In the table below there is given by counties the bonds issued to date, and also the amount issued during the year December 1, 1910, to November 30, 1911. Figures are also given as to the amount of bonds sold to date, date of sale, kinds of bonds, whether county or township, and, where the information could be had, the name of the township.

TABLE I—REVENUE BY BOND ISSUE.

County.	Amount of Bonds Issued to Nov. 30, 1911.	Amount of Bonds Issued Dec. 1, 1910, to Nov. 30, 1911.	Amount of Bonds Sold to Date.	Date of Sale.	Kind of Bonds, County or Township.	Name of Townships.
Alamance.....	\$400,000	\$.....	\$400,000	1908	county.....	Wadesboro.
Alexander.....						
Alleghany.....	50,000		50,000		township.....	
Anson.....						
Ashe.....						
Avery.....						
Beaufort.....						Black Mountain.
Bertie.....	25,000	20,000	25,000	{ \$ 5,000, 1907 20,000, 1911 }	{ township and county.	
Bladen.....	10,000		10,000	1908	township.....	
Brunswick.....	35,000	15,000	35,000	{ \$12,000, 1908 8,000, 1910 15,000, 1911 }	2 townships.	
Buncombe.....	20,000		20,000	1907	township.....	
Burke.....						
Cabarrus.....	40,000	40,000	40,000	1911	county.....	Valleytown, Murphy.
Caldwell.....						
Camden.....						
Carteret.....						
Caswell.....						
Catawba.....						
Chatham.....						No. 6, No. 4.
Cherokee.....	75,000		75,000	{ \$25,000, 1907 50,000, 1911 }	2 townships.	
Chowan.....						
Clay.....						
Cleveland.....	125,000		50,000	{ \$25,000, 1910 25,000, 1911 }	township.....	
Columbus.....						
Craven.....						No. 6, No. 4.
Cumberland.....						
Currituck.....						
Dare.....						
Davidson.....	100,000				township.....	
Davie.....						



TABLE I—Continued.

County.	Amount of Bonds Issued to Nov. 30, 1911.	Amount of Bonds Issued Dec. 1, 1910, to Nov. 30, 1911.	Amount of Bonds Sold to Date.	Date of Sale.	Kind of Bonds, County or Township.	Name of Townships.
Duplin.....	\$ 60,000	\$ 60,000	\$ 10,000	1911	township....	Parts of Island Creek and Rockfish, Warsaw and Rose Hill.
Durham.....						
Edgecombe.....						
Forsyth.....						
Franklin.....	110,000	70,000	110,000	{ \$40,000, 1909 70,000, 1911 100,000, 1905 200,000, 1908 }	3 townships.	Franklinton, Louisburg, Youngsville.
Gaston.....	300,000		300,000		county.....	
Gates.....						
Graham.....						
Granville.....	120,000		120,000	{ 1903 1909 }	county.....	
Greene.....						
Guilford.....	300,000		300,000	1905 to 1909	county.....	
Halifax.....						
Harnett.....						
Haywood.....						
Henderson.....						
Hertford.....						
Hoke.....	50,000	50,000	50,000	1911	county.....	
Hyde.....						
Iredell.....	400,000	400,000	125,000	1911	county.....	
Jackson.....						
Johnston.....						
Jones.....						
Lee.....	15,000		15,000		township....	
Lenoir.....						
Lincoln.....						
McDowell.....	5,000	5,000	5,000		township....	
Macon.....						
Madison.....	10,000	10,000	10,000	1911	township....	
Martin.....	40,000		15,000	1911	township....	Williamston.
Mecklenburg...	300,000		300,000		county.....	
Mitchell.....						
Montgomery.....						
Moore.....	32,000	10,000	32,000	{ \$22,000, 1910 10,000, 1911 }	3 townships.	McNeill, Carthage, and Sands Hill.
Nash.....	70,000	60,000	10,000	1907	5 townships.	
New Hanover..	200,000	50,000	200,000	{ \$50,000, 1902 50,000, 1905 50,000, 1907 50,000, 1911 }	county.....	Rocky Mount Road District, and So. Whitakers, No. Whitakers, Castalia, and Dry Wells.

TABLE I—Continued.

County.	Amount of Bonds Issued to Nov. 30, 1911.	Amount of Bonds Issued Dec. 1, 1910, to Nov. 30, 1911.	Amount of Bonds Sold to Date.	Date of Sale.	Kind of Bonds, County or Township.	Name of Townships.
Northampton.....	\$.....	\$.....	-----	-----	-----	Hillsboro.
Onslow.....	-----	-----	-----	-----	-----	
Orange.....	40,000	-----	40,000	1908	township....	
Pamlico.....	-----	-----	-----	-----	-----	
Pasquotank.....	10,000	-----	10,000	{ \$5,000, 1905 5,000, 1906 }	county.....	
Pender.....	-----	-----	-----	-----	-----	
Perquimans.....	-----	-----	-----	-----	-----	
Person.....	-----	-----	-----	-----	-----	
Pitt.....	-----	-----	-----	-----	-----	
Polk.....	12,000	12,000	12,000	1911	township....	Tryon.
Randolph.....	-----	-----	-----	-----	-----	
Richmond.....	100,000	-----	100,000	{ 1905 1907 1909 }	county.....	
Robeson.....	-----	-----	-----	-----	-----	
Rockingham.....	-----	-----	-----	-----	-----	
Rowan.....	-----	-----	-----	-----	-----	
Rutherford.....	-----	-----	-----	-----	-----	
Sampson.....	40,000	5,000	40,000	{ 1909 1910 1911 }	county.....	
Scotland.....	130,000	50,000	130,000	1909 to 1911	township....	
Stanly.....	-----	-----	-----	-----	-----	Wilson.
Stokes.....	-----	-----	-----	-----	-----	
Surry.....	-----	-----	-----	-----	-----	
Swain.....	-----	-----	-----	-----	-----	
Transylvania.....	-----	-----	-----	-----	-----	
Tyrrell.....	-----	-----	-----	-----	-----	
Union.....	-----	-----	-----	-----	-----	
Vance.....	20,000	-----	20,000	1904	county.....	
Wake.....	-----	-----	-----	-----	-----	
Warren.....	-----	-----	-----	-----	-----	
Washington.....	-----	-----	-----	-----	-----	Wilson.
Watauga.....	-----	-----	-----	-----	-----	
Wayne.....	-----	-----	-----	-----	-----	
Wilkes.....	-----	-----	-----	-----	-----	
Wilson.....	100,000	-----	100,000	1905 to 1910	township....	
Yadkin.....	-----	-----	-----	-----	-----	Wilson.
Yancey.....	-----	-----	-----	-----	-----	
Totals.....	\$3,344,000	\$ 857,000	\$2,759,000	-----	-----	



A review of this table shows that 33 counties in all have issued bonds; that 15 of these were either voted or issued during 1911; that 12 of these bond issues were made by the county as a whole; that 19 of the issues were made by townships; and that in two instances a county bond issue was supplemented by a township bond issue. For good road construction in the State there has been issued in all (including the county and township bonds), \$3,344,000.

Of this amount, \$857,000 were issued from December 1, 1910, to November 30, 1911. The amount of bonds sold to date (including county and township bonds) is \$2,759,000.

In the next table there is given as reported the revenue raised for road construction by taxation, whether county or township; the total amount raised; how the money is expended; rate of tax; rate of poll tax, and labor tax.

TABLE II—REVENUE BY TAXATION.

County.	Special Tax.		Amount Raised by Tax (Including Poll).	How Spent, Construction or Repair?	Rate of Property and Poll Tax.		Labor Tax.	
	How Levied, by County or Township?	Name of Township.			Rate of Tax on \$100 Worth of Property.	Rate of Poll Tax.	Number of Days Required.	Age Limits or Number of Men Subject to Tax.
Alamance	county		\$ 20,000	interest on bonds, repairing and grading.	\$ .16 $\frac{2}{3}$	\$ 2.25	3	21 to 45 years.
Alexander	township	Ellendale	5,000		.25	.75	old law for balance of county.	18 to 45 years.
Alleghany								
Anson	county, except 1 township.		14,000	repairs and construction.	.25			
Ashe	county		3,000	maintenance.	.10			
Avery								
Beaufort	county for 1911 and township.	Richland	15,000	repairing dirt roads	.13 $\frac{1}{2}$ and .10	2.00	6	18 to 45 years.
Bertie	county		10,143	repairs and construction.	.18 $\frac{1}{2}$		6 in 2 townships	don't know.
Bladen	township	Brown Marsh	1,000	interest on bonds and repairs.	.13	.39	4 days or \$2.00 a head.	3,300
Brunswick	county and township.		1,300	interest on bonds and repairs.	*.81 $\frac{1}{2}$ and .10	2.13 and .30	6	18 to 45 years.
Buncombe	county		156,968	construction and repairs.	.20		4 days or \$4.00	2,000
Burke	county		7,500	bridges, repairs, etc.	.20	.45	6	4,900
Cabarrus	county		24,000	construction and repairs.	.30			1,000
Caldwell								
Camden							6	2,500
Carteret	township		1,000	construction and repairs.			6	18 to 45 years.
Caswell	county for 1911-1912		6,500	repairing dirt roads	.10	.30	6	2,500
Catawba	county		18,000	repairing.	.30	.90	4	1,800
Chatham	county		6,635	repairing dirt roads	.20		4	4,500
					.10		4	3,000



Cherokee.....	2 townships.....	Murphy and Valleystown.	3,750	payment on bonds.....	Murphy Tp., .20 Valleystown Tp., .15 Marble Dist. of Valleystown Tp., .35	6 in Murphy Tp. 8 outside Mur- phy and Valley- town Tps.	18 to 45 years.
Chowan.....	township.....		4,000	repairs and construction.	Valley's Tp., .45 Marble Dist., 1.05		
Clay.....	county.....		1,700	repairing and grading.....	{ .22½ .60 .60	4	500
Cleveland.....	county and townships.		12,100	interest on bonds, re- pairs and construction.	First Tp., .07½ Bal. of county, .20 county, .10 (?) No. 1 Tp., .25 No. 2 Tp., .20 No. 6 Tp., .20	2 in other town- ships.	3,000
Columbus.....	county.....		8,048	repairing dirt roads.....	.10	6	3,300
Craven.....	township.....		17,270	repairing and sand-clay construction.	.10 and .25		
Cumberland.....	county.....		11,000	repairs.....	.10	6	18 to 45 years.
Currituck.....						6	18 to 45 years.
Dare.....						6	21 to 45 years.
Davidson.....	township.....		9,617	repairs and construction.	.15 and .20	6 where no spe- cial tax.	21 to 45 years.
Davie.....						6	18 to 45 years.
Duplin.....	township.....		3,070	interest on bonds.....	.20		
Durham.....	county.....		52,630	construction and repairs.	.20½		
Edgecombe.....	county.....		26,343	construction, repairs, and bridges.	.27		
Forsyth.....	county.....		75,000	construction and repairs.	.33½		
Franklin.....	3 townships.....		14,115	construction and repairs.	.30, .35, .25		
Gaston.....	county.....		34,000	interest on bonds, con- struction and repairs.	.25		
Gates.....						6	18 to 45 years.
Graham.....	county.....		3,500	repairs and construction.	.25½		
Granville.....	county.....		22,000	grading, construction, and interest on bonds.	.25	4	2,000
Greene.....							
Guilford.....	county.....		24,000	repairs and construction	.12½	2	4,200

\*By act of Legislature of 1911. No benefit to county during 1911.  
 †\$10,000 goes to road fund excess of what was formerly paid county officials who are now on salary.

TABLE II—Continued.

County.	Special Tax.		Amount Raised by Tax (Including Poll).	How Spent, Construction or Repair?	Rate of Property and Poll Tax.		Labor Tax.	
	How Levied, by County or Township?	Name of Township.			Rate of Tax on \$100 Worth of Property.	Rate of Poll Tax.	Number of Days Required.	Age Limits or Number of Men Subject to Tax.
Halifax	county*		\$ 25,000	repairing dirt roads	\$.20	\$.-----	6	18 to 45 years.
Harnett	2 townships	Lillington and Aversboro.	3,700	repairs and construction.	.20 and .25	Lillington Tp., .60	6, where no special tax.	18 to 45 years.
Haywood	county		4,000	grading, repairs, and construction.	.17	-----	6	1,200
Henderson	county		10,204	grading, repairs, and construction.	.20	-----	6	2,205
Hertford	township.		4,200	repairing dirt roads	.02 to .15	.06 to .45	6	18 to 45 years.
Hoke	county		5,000	interest on bonds and repairs.	.15	.45	-----	-----
Hyde	township.	Fairfield and Swan Quarter.	2,000	repairing dirt roads	.20	.60	6	18 to 45 years.
Iredell	county		31,400	interest and sinking fund for bond issue.	.23	.75	6	18 to 45 years.
Jackson	township.		7,000	repairing dirt roads	.20	-----	5	18 to 45 years.
Johnston	township.		4,000	construction and repairs.	.25	.75	6, where no special tax.	3,000
Jones	county		4,440	repairs.	.20	.60	-----	-----
Lee								
Lenoir	county		13,702	repairing dirt roads and construction.	.25	.75	-----	-----
Lincoln	township.		8,500	repairing dirt roads	.10, .15, .25	.40 and .60	-----	-----
McDowell	township.		10,000	construction in Marion Tp., repairs other tps.	.35 and .10	-----	6	1,000
Macon	township.		7,500	repairing dirt roads	.25	-----	4 days or \$2.00	1,700
Madison	county		4,000	grading	.15	-----	4	2,000
Martin	township.	Williamston.	2,000	interest on bonds	.20	.60	6	21 to 45 years.
Mecklenburg	county and township.		*63,695	construction and repairs.	.30	-----	4	21 to 45 years.



Mitchell.....	county.....	12,000	repairing dirt roads.....	.50	-----	4	2,000
Montgomery.....	township.....	15,400	repairing dirt roads.....	.10 and .20	-----	4	18 to 45 years.
Moore.....	5 townships.....	14,000	construction and repairs.....	.25	.75	16	800
Nash.....	township.....	30,000	construction and repairs.....	.20 and .30	.60 and .90	-----	-----
New Hanover.....	county.....	2,000	interest and sinking fund.....	.20	-----	4	350
Northampton.....	county.....	14,000	repairing dirt roads.....	-----	-----	3 days or \$1.00	2,341
Onslow.....	-----	-----	-----	-----	-----	4	18 to 45 years.
Orange.....	county and township.....	13,000	repairs and construction.....	.25	-----	4	1,000
Pamlico.....	county.....	4,000	repairing dirt roads.....	.20	-----	4	700
Pasquotank.....	county.....	12,000	repairs and construction.....	.15	.45	-----	-----
Pender.....	-----	-----	-----	-----	-----	8	18 to 45 years.
Perquimans.....	county.....	3,950	repairing dirt roads.....	.15	.45	6	18 to 50 years.
Person.....	county.....	4,800	repairing dirt roads.....	.15	-----	-----	-----
Pitt.....	county.....	10,180	repairs and construction.....	.15	-----	-----	-----
Polk.....	township.....	4,500	repairing dirt roads.....	.15 and .25	-----	4	1,000
Randolph.....	county.....	6,000	repairing dirt roads.....	.08½	-----	4	18 to 45 years.
Richmond.....	county.....	18,500	repairing dirt roads.....	.30	.90	-----	-----
Robeson.....	county.....	24,586	interest on bonds.....	.20	-----	-----	-----
Rockingham.....	county.....	22,156	construction and repairs.....	.19	1.00	-----	-----
Rowan.....	county.....	42,000	construction and repairs.....	.25	-----	4 days or \$2.50	485
Rutherford.....	township.....	2,500	repairing dirt roads.....	.20 and .10	.30 and .60	6	2,000
Sampson.....	county.....	7,000	interest on bonds and repairs.....	.10	-----	6	2,500
Scotland.....	township.....	11,137	interest on bonds and repairs.....	.16½ and .24½	-----	-----	-----
Stanly.....	county.....	4,367	repairs.....	.25 and .33	-----	4	2,000
				.09	.27		

\*Each township expends its own money.

†Estimated. ‡In townships which have no special tax.

§Except for nonpayment of poll tax, where 6 days are required as a fine.

TABLE II—Continued.

County.	Special Tax.		Amount Raised by Tax (Including Poll).	How Spent, Construction or Repair?	Rate of Property and Poll Tax.		Labor Tax.	
	How Levied by County or Township?	Name of Township.			Rate of Tax on \$100 Worth of Property.	Rate of Poll Tax.	Number of Days Required.	Age Limits or Number of Men Subject to Tax.
Stokes			\$		\$			
Surry	township	Mount Airy	4,000		.30	.90	6	18 to 45 years.
Swain	township		5,088	repairing dirt roads	.10		6	18 to 45 years.
Transylvania	township		3,290	repairing and grading	.15		4	18 to 45 years.
Tyrrell	township		2,400	repairing	.10	.30	5	18 to 45 years.
Union	township and county	Monroe, 22c	15,060	repairing dirt roads	.22 and .14	.66 and .30	6	3,500
Vance	county		8,000	repairing dirt roads	.10	.30		
Wake	county and township		75,000	construction and repairs	* .25 and .10		6	18 to 45 years.
Warren	township		12,000	repairing dirt roads	.25			
Washington								
Watauga							6	18 to 45 years.
Wayne	county		10,000	repairing dirt roads	.10		8	18 to 45 years.
Wilkes	county		6,000	repairing dirt roads and bridges	.10		6	18 to 45 years.
Wilson	township	Wilson	30,200	construction and repairs	† .25 and .22½	.75 and .67		
Yadkin							6	18 to 45 years.
Yancey	county		2,800	repairing dirt roads	.15		6	2,000
Total			\$ 1,137,354					

\*25 cents on \$1.00 general tax; 7 townships have additional special tax of 10 cents; a per capita dog tax of \$1.00 also goes to roads.

†Wilson Township, 25 cents; all others, 22½ cents.



An analysis of the above table will show that 46 counties have a special tax for road work, the tax being levied for the whole county. There is raised by this tax about \$712,140, the greater proportion of which is spent in repairing the dirt roads of the counties, in connection with the labor tax. Thirty-seven counties have a special road tax by townships, and the amount raised by this tax is \$425,214, giving a total of \$1,137,354 as the amount reported as raised by special tax for roads in the whole State. Of this amount \$133,120 is used to pay interest on bond issues, and \$1,004,234 is spent in repairs and construction. Of the 68 counties which have a labor tax, 34 reported an aggregate number of 71,281 men who work on an average of 5.3 days each during the year, making a total of 377,789 days of labor that were put on the roads in these counties. The other 35 counties reporting a labor tax gave the age limits of the men required to work and the number of days. Averaging the number of men who work the roads at 1,500 per county would give 52,500 who work the roads in these 35 counties, and averaging the number of days required during the year at 5 each, would give a total of 262,500 days work. This makes a grand total of 640,289 days of labor that were put on the public roads in the State during the year in the counties having a labor tax. Valuing this labor tax at \$1 per day, it is equal in value to \$640,249 which is spent on the roads of the 68 counties referred to above. In those counties which had this labor tax only 37 reported any improved roads, which demonstrated very conclusively that improved roads cannot be obtained by the labor tax. All of the counties which report improved roads have either a special tax or bond issue for building them.

This shows that by this system of road work the time of the citizen is worse than wasted, and that the State yearly is losing the equivalent of at least \$600,000 by such a system.

The next table gives the officials by whom the expenditure of road revenue is made; also how the money is expended, whether as a general county road fund or by townships; and future work contemplated in the various counties.

TABLE III—EXPENDITURE OF REVENUE AND FUTURE WORK CONTEMPLATED.

County.	Officials Who Supervise Expenditure of Road Money.	How Money is Expended, General County Road Fund or by Township.	Future Work Contemplated.
Alamance.....	County commissioners.....	County.....	Repairing 8-year-old macadam.
Alexander.....	Township supervisors.....	Township.....	
Alleghany.....	County commissioners.....	County.....	Hope to improve roads under old system.
Anson.....	County commissioners.....	County.....	Expect to vote on \$300,000 bond issue.
Ashe.....	Road trustees in different townships.	Township.....	Hope to gradually improve our most important roads.
Avery.....			
Beaufort.....	Township road commissioners.	Township.....	
Bertie.....	County commissioners.....	Township.....	Continue present work.
Bladen.....	Township road commissioners.	Township.....	Some work in Brown Marsh Township.
Brunswick.....	Township road commissioners.	Township.....	Town Creek will spend \$20,000 bond issue.
Buncombe.....	County commissioner*.....	County.....	Expect to build roads Biltmore to Fairview, 10 miles, and Biltmore to Black Mountain, 10 miles.
Burke.....	County commissioners.....	County.....	
Cabarrus.....	County commissioners.....	County.....	Expect to grade and macadamize 3 miles.
Caldwell.....	Township commissioners.....	Township.....	
Camden.....			
Carteret.....	Township commissioners.....	Township.....	Expect to complete 5 miles of Central Highway through Carteret by private subscription.
Caswell.....	Township trustees.....	Township.....	Extend one started through center of county.
Catawba.....	Township superintendents	County.....	Contemplate bond issue.
Chatham.....	Road commissioners.....	County.....	
Cherokee.....	Township commissioners.....	Township.....	Continue work already begun.
Chowan.....	Township trustees.....	Township.....	
Clay.....	Township supervisors.....	Township.....	
Cleveland.....	Township commissioners.....	Township.....	Connecting Shelby with Kings Mountain by soil-surfaced road.
Columbus.....	County commissioners.....	County.....	
Craven.....	Township commissioners.....	Township.....	Work on Central Highway.
Cumberland.....	County commissioners.....	County.....	Contemplate bond issue.
Currituck.....	Township supervisors.....	Township.....	
Dare.....			
Davidson.....	Township trustees.....	Township.....	
Davie.....			
Duplin.....	Township commissioners.....	Township.....	Bond issue contemplated.
Durham.....	County commissioners.....	County.....	Two roads under construction.
Edgecombe.....	County commissioners.....	County.....	General repair work.
Forsyth.....	County commissioners and township supervisors.	County.....	
Franklin.....	Road commissioners.....	Township.....	Continue same work.

\*Except Black Mountain Township, which has its own commissioners and expends its funds.



TABLE III—*Continued.*

County.	Officials Who Supervise Expenditure of Road Money.	How Money is Expended, General County Road Fund or by Township.	Future Work Contemplated.
Gaston.....	County commissioners....	County.....	Continue present work.
Gates.....	County commissioners....	County.....	Contemplate bond issue.
Graham.....	County commissioners....	County.....	
Granville.....	County commissioners....	County.....	
Greene.....			
Guilford.....	County commissioners....	County.....	Continue sand-clay work.
Halifax.....	County commissioners....	Township.....	Contemplate bond issue.
Harnett.....	Township road commis- sioners.	Township.....	Bond issue will be voted on.
Haywood.....	County commissioners....	County.....	Grading and preparing for sand- clay.
Henderson.....	County commissioners and road supervisors.	Township.....	
Hertford.....	Road supervisors.....	Township.....	
Hoke.....	County commissioners....	County.....	
Hyde.....	Road commissioners.....	Township.....	
Iredell.....	County commissioners....	County.....	Construction of county system of roads under bond issue.
Jackson.....	Township commissioners....	Township.....	
Johnston.....	Township road commis- sioners.	Township.....	Finish Central Highway.
Jones.....	County commissioners....	County.....	
Lee.....	Township road commis- sioners.	County.....	Bond issue contemplated.
Lenoir.....	County commissioners....	County.....	Work on Central Highway.
Lincoln.....	County commissioners....	Township.....	Bond issue contemplated.
McDowell.....	Township commissioners....	Township.....	Marion Township contemplates construction of sand-clay roads.
Macon.....	Township road commis- sioners.	Township.....	
Madison.....	County road commis- sioners.	Township.....	Grading and crowning.
Martin.....	County commissioners....	County.....	
Mecklenburg.....	County commissioners....	County.....	Continuing present work.
Mitchell.....	County commissioners....	County.....	Construction of graded dirt road from Bakersville to Toecane.
Montgomery.....	Township supervisors....	Township.....	
Moore.....	County commissioners and township commissioners.	Township.....	Building 20 miles new road.
Nash.....	Township road commis- sioners.	Township.....	Grading and sand-clay work.
New Hanover.....	County commissioners....	County.....	Continue macadam work.
Northampton.....	County and township road commissioners.	County, except one township.	Want bond issue.
Onslow.....			
Orange.....	Road supervisors.....	Township.....	Contemplate bond issue.
Pamlico.....	Township road commis- sioners.	Township.....	
Pasquotank.....	County commissioners....	County.....	
Pender.....	Township commissioners....	Township.....	
Perquimans.....	County commissioners....	County.....	Bond issue contemplated.
Person.....	County commissioners....	County.....	

TABLE III—*Continued.*

County.	Officials Who Supervise Expenditure of Road Money.	How Money is Expended, General County Road Fund or by Township.	Future Work Contemplated.
Pitt.....	County commissioners....	County.....	Bond issue contemplated.
Polk.....	Township road commis- sioners.	Township.....	
Randolph.....	Township road commis- sioners.	Township.....	
Richmond.....	County commissioners....	County.....	
Robeson.....	Township commissioners..	Township.....	Continue present work.
Rockingham.....	County commissioners....	County†.....	
Rowan.....	County commissioners....	Township.....	Sand-clay construction and repairs to all roads in county.
Rutherford.....	County commissioners and township supervisors.	Township.....	Grading. Bond issue talked of.
Sampson.....	County road commis- sioners.	County.....	Bond issue talked of.
Scotland.....	Township road commis- sioners.	Township.....	
Stanly.....	County commissioners....	County.....	Building sample road under super- vision of U. S. Government.
Stokes.....	.....	.....	
Surry.....	Township road commis- sioners.	Township.....	
Swain.....	Township road commis- sioners.	Township.....	
Transylvania.....	Township supervisors....	Township.....	
Tyrrell.....	Township commissioners..	Township.....	
Union.....	Township commissioners..	Township.....	Bond issue contemplated.
Vance.....	County commissioners....	County.....	Expect to build 5 miles of sand- clay.
Wake.....	County commissioners and township trustees.	County.....	Macadam, sand-clay, and gravel- ing.
Warren.....	Township road commis- sioners.	Township.....	
Washington.....	.....	.....	
Watauga.....	County commissioners....	County.....	General improvement.
Wayne.....	County commissioners....	County.....	Sand-clay work.
Wilkes.....	Township commissioners..	County.....	Construct road from No. Wilkes- boro to Taylorsville, northwest to Fredell line.
Wilson.....	County commissioners....	County.....	General road work.
Yadkin.....	County commissioners....	County.....	
Yancey.....	County commissioners....	Township.....	Talk of bond issue.

†Except \$9.00 on the poll, which is spent by township commissioners.



As will be seen from the above table, the road funds are expended by various officials. In the majority of cases, however, they are in the hands of the county commissioners; 13 counties hope to pass a bond issue; 53 counties expect to do improved road work of some kind during 1912; while 41 counties have no plans for any road improvement.

#### ROAD MILEAGE IN NORTH CAROLINA.

Table IV, given below, gives the estimated total mileage of public roads in North Carolina, the number of miles of macadam, sand-clay, gravel, specially surfaced and graded dirt roads in the State, by counties, and the number of miles of these roads constructed during the year 1911. There is also given the number of miles of unimproved dirt road. The average cost per mile of the macadam, sand-clay, and gravel is given in some instances.

TABLE IV.—ROAD MILEAGE.

County.	Number Miles of Public Road in County (Estimated).	Macadam Road.		Sand-clay Road.		Gravel Road.		Specially Surfaced.			Number Miles of Road Graded Dec. 1, 1910, to Nov. 30, 1911.	Average Cost Per Mile of—		
		Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Kind.	Number Miles in County.		Macadam.	Sand-clay.	Gravel.
Alamance.....	640	47	2	7	6			$\frac{1}{2}$		$\frac{1}{2}$	10	\$.....	\$.....	\$.....
Alexander.....	500										500			
Alleghany.....	260										260			
Anson.....	500	25	16	34	8	30	16				411		300	1,000
Ashe.....	500							few			500			
Avery.....	600										600			
Beaufort.....	400			2							398			
Bertie.....	850			1	1	250	50				50			
Bladen.....	200			3	2						599			
Brunswick.....	400			20	8						197			
Buncombe.....	600	68	8	15	8						380		1,000	
Burke.....	500			2 $\frac{1}{2}$	2 $\frac{1}{2}$						517		3,500	1,000
Cabarrus.....	350	20				10	3				50		300	
Caldwell.....	600	6	3	2	2			5	asphalt macadam.		3			1,000
Camden.....	150										30			
Carteret.....	150			*5	5						150			
Caswell.....	500	2									145		500	
Catawba.....	450										498			
											450			





TABLE IV—Continued.

County.	Number Miles of Public Road in County (Esti- mated).	Macadam Road.		Sand-clay Road.		Gravel Road.		Specially Surfaced.			Number Miles Dirt Road Graded Dec. 1, 1910, to Nov. 30, 1911.	Average Cost Per Mile of—		
		Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles in County.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Kind.	Number Miles in County.		Mac- adam.	Sand- clay.	Gravel.
Henderson.....	800		15	3						40	785			
Hertford.....	600										600			
Hoke.....	200										200			
Hyde.....	250										250			
Iredell.....	375	30	6	6							369			
Jackson.....	400										400			
Johnston.....	800		100	20	15	5				50	685			
Jones.....	400		4	2							396			
Lee.....	300		1								299			
Lenoir.....	600		15	8							585			
Lincoln.....	400		1½	1½							398½	1,800		
McDowell.....	350	6									344			
Macon.....	750										750			
Madison.....	300										300			
Martin.....	425		7	7							418	1,500		
Mecklenburg..	850	290			18	16	12	12			530	3,250		
Mitchell.....	500										500			
Montgomery...	300		20	10							280		100	



Moore.....	600			200	75								400		300		
Nash.....	800			50	20								750		200		
New Hanover..	125	55	6	5	5						6	6 oil	59	3,800	600		
Northampton..	675												675				
Onslow.....	350												350				
Orange.....	300	10				10	2					4	280	8,000		300	
Pamlico.....	200												200				
Pasquotank...	225												225				
Pender.....	500												500				
Perquimans...	325												325				
Person.....	600												600				
Pitt.....	900			5	3							20	895		50		
Polk.....	300	3											297				
Randolph.....	400												400				
Richmond.....	450			200	50	25	5						225		350	400	
Robeson.....	900			25	20							20	875				
Rockingham...	600	15	3	5	5								580				
Rowan.....	400	115	35	38	38						12	12	235	2,300	350		
Rutherford.....	600			14	14						several		598 <sup>3</sup>		2,000		
Sampson.....	800			90	21								710		400		
Scotland.....	300			150	40								150		300		
Stanly.....	550												550				
Stokes.....	400												400				
Surry.....	350												350				
Swain.....	300												300				
Transylvania..	200												200				

TABLE IV—Continued.

County.	Number Miles of Public Road in County (Estimated).	Macadam Road.		Sand-clay Road.		Gravel Road.		Specially Surfaced.			Number Miles Dirt Road Graded Dec. 1, 1910, to Nov. 30, 1911.	Number Miles Dirt Road Unimproved (Estimated).	Average Cost Per Mile of—	
		Number Miles in County. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles in County. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Number Miles in County. 1, 1910, to Nov. 30, 1911.	Number Miles Built from Dec. 1, 1910, to Nov. 30, 1911.	Kind.	Macadam.	Sand-clay.			Gravel.	
Tyrrell.....	200										200			
Union.....	900	4									896			
Vance.....	400										400			
Wake.....	1,000	5		20		100	20				875		600	600
Warren.....	400										400			
Washington.....	250										250			
Watauga.....	300										300			
Wayne.....	1,000			75		25					900		350	
Wilkes.....	800										800			
Wilson.....	700	30		1							669	4,000	1,050	
Yadkin.....	300										300			
Yancey.....	200										200			
Totals.....	48,235	1,175	187	1,502	549	683	297	80½	59½		491	44,785½		

\* Built by private subscription.



A review of this table shows that the total mileage of public roads in North Carolina amounts to 48,235 miles, of which there are 1,175 miles of macadam, 1,502 miles of sand-clay, 683 miles of gravel, and 89½ miles of specially surfaced road, making a total of 3,449½ miles of improved road in the State. There was also reported 491 miles of graded dirt road which has not been surfaced and is not included under the head of *improved roads* in this report. This leaves a total mileage of unimproved roads of 44,785½ miles. Of the above mileage of improved roads, there were constructed during 1911, 187 miles of macadam, 549 miles of sand-clay, and 297 miles of gravel, making a total of 1,033 miles of surfaced road constructed during 1911. There were 9 counties which reported the cost per mile of the construction of macadam, which was \$3,650; 27 counties reported the average cost per mile of the sand-clay road as \$746; and 7 counties reported the cost of the gravel road, which averaged \$691.

#### CONVICT LABOR IN ROAD CONSTRUCTION.

The next table relates to the use of convicts in road work in North Carolina, and gives by counties the number of convicts used, indicating which counties lease their convicts for such work. Data have also been received from a few counties relating to the average cost of maintaining the convict, a comparison as to the work of the convict with that of hired labor, and the effect upon the convict of such work.

TABLE V—USE OF CONVICTS IN ROAD WORK IN NORTH CAROLINA.

County.	Use of Convicts in Road Construction.		Average Cost of Maintaining Convict.	Cost as Compared to Hired Labor.	Effect of Such Work Upon Convict.
	Average During Year.	Leased to Other Counties.			
Alamance.....	30		50 cents.....	50 per cent cheaper.	improve morally and physically.
Alexander.....					
Alleghany.....		lease			
Anson.....	33				
Ashe.....					
Avery.....		lease			
Beaufort.....	30				
Bertie.....					
Bladen.....					
Brunswick.....		lease			
Buncombe.....	60				
Burke.....					
Cabarrus.....	30				
Caldwell.....		lease			
Camden.....					
Carteret.....					
Caswell.....		lease			
Catawba.....					
Chatham.....		lease			
Cherokee.....		lease			
Chowan.....		lease			
Clay.....		lease			
Cleveland.....	41				
Columbus.....	35				
Craven.....	25		43 cents.....	better.....	improves health.
Cumberland.....	20				
Currituck.....					
Dare.....					
Davidson.....	8				
Davie.....					
Duplin.....					
Durham.....	80				
Edgecombe.....	25		72 cents.....	cheaper and better.	improves health, but not the morals.
Forsyth.....	90				
Franklin.....	10				
Gaston.....	60				



TABLE V—Continued.

County.	Use of Convicts in Road Construction.		Average Cost of Maintaining Convict.	Cost as Compared to Hired Labor.	Effect of Such Work Upon Convict.
	Average During Year.	Leased to Other Counties.			
Gates.....		lease.....			
Graham.....					
Granville.....	18				
Greene.....					
Guilford.....	65		\$10 per month.	better.....	favorable.
Halifax.....	30				
Harnett.....	25				
Haywood.....	28				
Henderson.....	30	lease.....	\$12 per month.	favorably...	improves health.
Hertford.....		lease.....			
Hoke.....					
Hyde.....					
Iredell.....	20				
Jackson.....					
Johnston.....	25				
Jones.....					
Lee.....					
Lenoir.....	25				
Lincoln.....					
McDowell.....	16	9			
Macon.....					
Madison.....					
Martin.....					
Mecklenburg.....	115				
Mitchell.....					
Montgomery.....					
Moore.....		lease.....			
Nash.....	45				
New Hanover.....	90		42 cents.....	better.....	
Northampton.....		lease.....			
Onslow.....		lease*.....			
Orange.....		lease.....			
Pamlico.....	30				
Pasquotank.....	35				
Pender.....		lease.....			
Perquimans.....	*				

TABLE V—*Continued.*

County.	Use of Convicts in Road Construction.		Average Cost of Maintaining Convict.	Cost as Compared to Hired Labor.	Effect of Such Work Upon Convict.
	Average During Year.	Leased to Other Counties.			
Person.....	8				
Pitt.....	31				
Polk.....		lease			
Randolph.....		lease			
Richmond.....		lease			
Robeson.....	25				
Rockingham.....	40				
Rowan.....	60				
Rutherford.....		lease			
Sampson.....	22		\$150 per year	cheaper	improves physically and morally.
Scotland.....		lease			
Stanly.....					
Stokes.....					
Surry.....					
Swain.....		lease			
Transylvania.....	7				
Tyrrell.....					
Union.....	50				
Vance.....		lease			
Wake.....	66				
Warren.....	6				
Washington.....					
Watauga.....		lease			
Wayne.....	35				
Wilkes.....					
Wilson.....	30+		60 cents per day.	better	good.
Yadkin.....					
Yancey.....		lease			

\*By order of judge, for which county gets no compensation.



As will be seen from the above table, 42 counties work their convicts on their roads, with a total of 1,454 men, who worked on the roads during the year. Twenty-six counties lease their convicts to other counties for road work.

The principle which obtains in the punishment of the criminal is the prevention of crime both by reforming or permanently confining him, and by deterring others from following his example. In the accomplishment of this purpose it has come to be generally admitted that during the infliction of punishment the physical health of the prisoner should not be impaired, and that everything possible should be done looking to such improvement of his character as may fit him for better citizenship.

Another principle, in no sense out of harmony with the first, and which, in this connection, is worthy of more general acceptance, is that the prisoner who has injured a community through the commission of crime, and whose capture, conviction, and punishment have added to its financial burden, should, if possible, in connection with his punishment do something to benefit the community which he has injured. Because of this principle the belief has widely become prevalent that perhaps the best way in which a criminal can benefit the community which he has injured is by helping to improve its public highways, and, in doing this work without compensation and at a cost actually less in many cases than that of his keep in the county jail, he is benefiting his community without imposing on it an additional tax burden; he is not in the ordinary sense competing with hired labor; and he is doing a work which hired labor does not care to do unless paid such wages as would prove too serious a drain on the public treasury. The laws of all the States which employ the convicts in the public road work specify that only able-bodied male convicts are to be assigned to work on the public roads. The experience in North Carolina has been that all the able-bodied male prisoners whose terms of sentence do not exceed ten years may be successfully employed at the ordinary work of highway improvement. It is felt that not only the convicts of short terms, but those of long terms, and even unconvicted prisoners, could be used to advantage on the public roads. The consent of the prisoner would have to be obtained for such an arrangement in the latter case, and he should be reimbursed for his work in case he is not convicted when his trial comes up.

Convict labor can be employed in building public roads so that the treatment of the convict both in regard to his labor and health will be carried out to the best advantage of the State, of the citizen, and of the convict. Statistics show that where the convict camp has been

well maintained and kept sanitary, and is under the supervision of competent men, that the health of the convict is improved and frequently their experience as road builders has improved their general character and prepared them for better citizenship. It is a matter of record that many convicts connected with the road camps who have behaved themselves properly and performed their work efficiently, thereby gaining the confidence of their guards, have been able to obtain positions in or near the communities where they had previously worked while in camp. It is necessary that the prisoner should be made to realize his indebtedness to society, and that the work that is being required of him is simply in payment of this debt, and therefore in his road work he is simply fulfilling an obligation. It is believed as our convicts begin to realize this it will tend to make them see the justness of their punishment, and they will look upon their work as something to be performed not as a punishment, but as a fulfillment of an obligation, which spirit will undoubtedly pave the way for making better men and citizens.

#### PROGRESS OF ROAD WORK IN NORTH CAROLINA BY COUNTIES.

As already stated, during the past two years the North Carolina Geological and Economic Survey, in coöperation with the United States Office of Public Roads, has collected monthly data in regard to road work in North Carolina, which have been arranged by counties. In the following pages is given a summary of the data collected during 1911 and, in connection with this, there is given the total mileage of the public roads in each county; mileage of improved roads, and the mileage of unimproved roads. An estimate is made of the cost to the citizens of the county during the year of the unimproved roads, reckoned on the basis of hauling one ton a distance of one mile, as shown in the following table, which has been worked out by experts:

On sand-clay road in good order.....	8.00 cents.
On earth road, dry and hard.....	18.00 cents.
On earth road, with ruts and mud.....	39.00 cents.
On gravel, loose.....	51.60 cents.
On gravel, compacted.....	12.80 cents.
On sand, wet.....	32.60 cents.
On sand, dry.....	64.00 cents.

In making the calculation as to the loss to the citizens of the county, it is made on the basis of five teams passing over each mile of road each day in the year. This is probably a low estimate, as the probable number of miles over which more than five teams would pass would undoubtedly greatly exceed the number of miles over which less than



five teams would pass. This calculation allows for the hauling of 1,000 pounds at a load. The cost of hauling a similar load over a mile of sand-clay road in good order is deducted from the amount used in the calculation as the cost of hauling over any type of bad road.

## ALAMANCE COUNTY.

Number of miles of public road in county.....	640
Number of miles of improved road in county.....	64½
Number of miles of unimproved road in county.....	575½
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$79,773

Alamance is situated in the Piedmont plateau and is a county of large agricultural and manufacturing interests. It has a bond issue of \$400,000, which were sold in 1908. Out of this bond issue she has built forty-seven miles of macadam road which has not been maintained. The mistake made by Alamance in the first instance was the attempt to decide upon the kind of roads needed in the county without the advice of a skilled engineer. The result is that she has a limited mileage of good roads, many of these being poorly constructed, and with a debt. The cheaper sand-clay road would have given better service, except, perhaps, in the immediate vicinity of Burlington and Graham, and it would have been possible to have obtained a greater mileage of surfaced roads out of the bond issue and a form of road that is easier to maintain than the macadam.

## ALEXANDER COUNTY.

Number of miles of public road in county.....	500
Number of miles of unimproved road in county.....	500
Character of unimproved roads—Earth, with ruts, mud, stone, and steep grades.	
Annual loss to county because of unimproved roads.....	\$109,500

This county is in the Piedmont plateau just to the east of the mountain region. The first interest manifested for good roads in Alexander County was at a meeting held at Taylorsville on July 18, 1911. It was the intention of the county commissioners to construct a three-mile stretch of road on the highway extending from the Iredell County line to the Caldwell County line. Through some discrepancy in the law, however, it was found that this could not be done, and an effort was made to raise the money by private subscription.

## ALLEGHANY COUNTY.

Number of miles of public road in county.....	260
Number of miles of unimproved road in county.....	260
Character of road—Earth, with ruts, mud, and steep grades.	
Annual loss to county because of unimproved roads.....	\$56,940

Very little interest has been shown in road improvement in this county to date.

## ANSON COUNTY.

Number miles of public road in county.....	500
Number of miles of improved road in county.....	89
Number of miles of unimproved road in county.....	411
Character of unimproved roads—Partly earth, with ruts, mud, and sand.	
Annual loss to county because of unimproved roads.....	\$109,511

Considerable interest has been shown by Anson County in improved roads. A special act was passed by the Legislature of 1911, permitting the county to vote a bond issue, and on May 2, 1911, a vote was taken on a \$300,000 bond issue. This failed to carry. One precinct in Lanesboro Township, Anson County, was authorized by the Legislature to make a special tax of 25 cents for building good roads. There has been, however, considerable effort made on the part of good roads advocates in the county to secure better roads, and there have been many subscriptions made for the encouragement of good roads sentiment in the county and also for the actual construction of some links of road. The county has a Good Roads Association.

## ASHE COUNTY.

Number of miles of public road in county.....	500
Number of miles of unimproved road in county.....	500
Character of road—Earth, with ruts, and mud, and heavy grades.	
Annual loss to county because of unimproved roads.....	\$109,500

The General Assembly of 1911 authorized Ashe County to issue a special tax of 30 cents on property and 90 cents on poll for 1912 and 1913 for good roads. During the year 1911, however, the tax money had not become available for the construction of improved roads. It is hoped that in the report for 1912 that Ashe will make a better showing.

## AVERY COUNTY.

Number of miles of public road in county.....	600
Number of miles of unimproved road in county.....	600
Character of road—Earth, with ruts, mud, and heavy grades.	
Annual loss to county because of unimproved roads....	\$219,000



Avery is a new county just established by the Legislature of 1911, and has not yet got under way with her county affairs.

#### BEAUFORT COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	2
Number of miles of unimproved road in county.....	398
Character of unimproved roads—Wet and dry sand.	
Annual loss because of unimproved roads in the county..	\$121,727

Considerable interest has been awakened in Beaufort County in good roads, and the Legislature of 1911 passed an act in regard to the issuance of \$100,000 in bonds. Special acts were also passed for certain townships—Washington, Chocowinity, Long Acre, and Richmond—providing for a special tax for road purposes. In the latter part of the year the Beaufort County Good Roads Association was organized.

#### BERTIE COUNTY.

Number of miles of public road in county.....	850
Number of miles of improved road in county.....	251
Number of miles of unimproved road in county.....	599
Character of unimproved roads—Earth, with ruts and mud and sand (wet and dry).	
Annual loss because of unimproved roads.....	\$159,603

The Legislature of 1911 passed an act allowing a special tax of 20 cents on the \$100 of property, to keep up bridges and make sample roads, this tax to continue for two years. Bertie County was also authorized to issue bonds to the extent of \$15,000 for road tools and machinery. This county lies in the Coastal Plain section of the State, where sand-clay roads can be built to the best advantage and at the least expense, and there is no reason why the county of Bertie should not have a system of excellent roads at much less expense than some of the other counties of the State, and thus obviate the high tax she is now paying to bad roads.

#### BLADEN COUNTY.

Number of miles of public road in county.....	200
Number of miles of improved road in county.....	3
Number of miles of unimproved road in county.....	197
Character of road—Mostly sand.	
Annual loss because of unimproved roads.....	\$58,210

Very little interest has been awakened in Bladen County in better roads. During the latter part of the year, however, the farmers of the county petitioned the county commissioners to call an election on

bonds for good roads and also for the establishment of a chain-gang for road purposes. The building of sand-clay roads in Bladen County should be a comparatively easy proposition, and the county should lose no time in lifting the burdensome tax for bad roads which it is now constantly paying.

#### BRUNSWICK COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	20
Number of miles of unimproved road in county.....	380
Character of unimproved roads—Mostly sand, wet and dry.	
Annual loss because of unimproved roads.....	\$113,040

The Legislature of 1911 passed an act allowing a special tax for Brunswick County of 81½ cents on the \$100 worth of property, and \$2.13 on the poll. This act did away with the labor tax. Towns Creek Township in Brunswick County voted bonds to the amount of \$15,000, which money was to become available on May 1, 1911. This money was to be expended in the building of sand-clay roads. Brunswick is in the Coastal Plain region of the State, and the sand-clay proposition is the easiest and best one for the county.

#### BUNCOMBE COUNTY.

Number of miles of public road in county.....	600
Number of miles of improved road in county.....	83
Number of miles of unimproved road in county.....	517
Character of unimproved roads—Earth, with ruts, mud, stones, and steep grades.	
Annual loss because of unimproved roads in the county..	\$117,246

The first County Good Roads Association in the State was organized in Buncombe County, when the Asheville and Buncombe County Good Roads Association came into existence. This Association continues to be the most active one in the State, not only in arousing sentiment in favor of good roads, but in the actual building and maintenance of certain stretches of road. This Association, in coöperation with the Asheville Motor Club and other organizations in the city of Asheville, have worked most harmoniously and effectively for better roads in this county, and the results are now being seen. Two years ago a sample of sand-clay road was built in Buncombe County under the supervision of Mr. W. L. Spoon, who was then the highway engineer of the Geological Survey, and this road has proved such an efficient one that it is believed the sand-clay road will be the best and cheapest road to build in most sections of the county. As an illustration of the broad interest which the Buncombe County Good Roads



Association is taking in highway work, not only within the borders of Buncombe County, but in the State at large, the following resolutions passed in 1911 are appended:

*"Resolved*, That we, the directors of the Good Roads Association of Asheville and Buncombe County, regret exceedingly that the Board of County Commissioners of Buncombe County have deemed it advisable to discontinue the employment of a standing road engineer for the county. We hope that they will at no distant date reconsider their action in this matter.

*"Resolved further*, That we favor legislation for this county tending to encourage the use of wide tires. We invite the attention of the members of the Legislature of this county to legislation on this subject for Charlotte Township, Mecklenburg County (Laws 1901, ratified March 4, 1901), and request them to endeavor to secure the passage of similar legislation for this county, *if it cannot be secured for the entire State.*"

#### BURKE COUNTY.

Number of miles of public road in county.....	500
Number of miles of improved road in county.....	2½
Number of miles of unimproved road in county.....	497½
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads....	\$105,533

Little interest is manifested in Burke County in the improvement of roads. During September, 1911, in connection with the mapping out of the Central Highway which runs through Burke, Mr. H. B. Varner made a number of speeches and organized Township Good Roads Associations in Hildebran, Connelly Springs, Morganton, Drexel, Glenn Alpine, and Bridgewater townships. So far as is known, however, these township associations have done but little work.

#### CABARRUS COUNTY.

Number of miles of public road in county.....	350
Number of miles of improved road in county.....	63
Number of miles of unimproved road in county.....	287
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$60,234

During the year 1911, 4¼ miles of road extending from Concord to Kannapolis were resurfaced with petroleum asphalt. Meetings were held in Cabarrus County during August and November in favor of better roads. These were addressed by the State Geologist.

#### CALDWELL COUNTY.

Number of miles of public road in county.....	600
Number of miles of improved road in county.....	8
Number of miles of unimproved road in county.....	592
Character of unimproved roads—Earth, with ruts and mud and steep grades.	
Annual loss to the county because of unimproved roads..	\$123,850

No road work of especial importance has been done by Caldwell County as a county. A company has built a toll-road known as the Hibriten Turnpike. Little River Township in Caldwell County organized a township good roads association in August, 1911, and has agitated the question of good roads considerably. This is another county in which the sand-clay road could be used to advantage, and a bond issue of \$400,000 would give sand-clay roads all over the county. The annual cost to the county of these bonds would be very slight in comparison to the very high tax the county is now paying to bad roads.

## CAMDEN COUNTY.

Number of miles of public road in county.....	150
Number of miles of unimproved road in county.....	150
Character of unimproved roads in county—Sand (wet and dry).	
Annual loss to the county because of unimproved roads....	\$44,211

Camden County is situated in the Coastal Plain region of the State, and the greater portion of this county has large quantities of sand. The only difficulty would be to get the proper clay with which to build the roads, and this could be hauled to advantage, even from a distance, because of the small percentage of clay required as compared to the amount of sand necessary to make a first-class sand-clay road. Little interest has been shown in Camden County in better roads.

## CARTERET COUNTY.

Number of miles of public road in county.....	150
Number of miles of improved road in county.....	5
Number of miles of unimproved road in county.....	145
Character of unimproved roads—Sand (wet and dry).	
Annual loss to county because of unimproved roads.....	\$42,737

Carteret County is located in the extreme eastern portion of the State, bordering on the Atlantic Ocean. Morehead City, located in this county, is the extreme eastern terminus of the Central Highway. No interest was felt in better roads in Carteret County until the question of the location of this highway came up, when a number of the more progressive citizens of both Beaufort and Morehead City became interested in the building of the link of this great highway which passes through that county. Very little, if anything, has been done by the county, but private subscriptions were raised and a link of five miles of sand-clay road built, part of it under the supervision of one of the engineers of the United States Office of Public Roads. This section of road, which was well built and properly clayed, stood up



well during the winter of 1911-'12, but a portion of the road had too much clay and did not stand up well. It is felt that this highway will serve as an object-lesson to the balance of the county and that eventually Carteret County will fall in line and construct sand-clay roads all over the county at a comparatively small cost.

## CASWELL COUNTY.

Number of miles of public road in county.....	500
Number of miles of improved road in county.....	2
Number of miles of unimproved road in county.....	498
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to the county because of unimproved roads..	\$104,518

Caswell County lies in the middle of the Piedmont section of North Carolina on the northern border of the State. It is essentially an agricultural county, having a number of small towns, but no large ones. The principal crop is tobacco, and the markets for this tobacco are Reidsville, Roxboro, and Danville. Because of these conditions, it is eminently necessary that the farmers should have good roads in order to market their products with the least expenditure of money and loss of time to themselves and also so that they can take advantage of the best market prices at any time of the year. But few counties in the State suffer from the lack of good roads more than Caswell, and the above estimate of the annual loss to the county because of bad roads is undoubtedly very low.

The Legislature of 1911 amended the road law for Caswell County and created a special tax of not to exceed 30 cents on the \$100 worth of property and 90 cents on the poll. This tax applies to the whole county, but the money is to be expended by townships. Each township has road trustees. This is one of the counties in which road building is made easy by an abundant supply of both sand and clay, and there is no reason why Caswell County should not have a good system of roads by the issuance of, say, \$300,000 in bonds. Such a bond issue could undoubtedly be retired at the end of forty years by the use of the present tax and a system of roads could be had which would benefit the present generation and add to the richness of the county.

## CATAWBA COUNTY.

Number of miles of public road in county.....	450
Number of miles of unimproved road in county.....	450
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to the county because of unimproved roads...	\$94,444

A great deal of agitation has been going on during 1911 in this county for the cause of good roads. The newspapers, the Hickory

Chamber of Commerce, and the Newton Boosters' Club have given inspection trips to the farmers to counties which have good roads. The progressive citizens of the county have been agitating the question during the whole year. The Legislature of 1911 reenacted all the laws of 1901 and 1907 for Catawba, the law of 1901 providing for the issuance of coupon bonds by the several townships in Catawba County, not to exceed \$50,000 for any one township. It is expected that Newton and Hickory townships will vote on this question early in 1912.\* In April, 1911, a petition was presented to the county board of commissioners, signed by 2,100 persons, requesting them to levy a road tax of 20 cents on the \$100.

During the year a magnificent steel bridge across Catawba River between the counties of Catawba and Alexander was opened to traffic.

The owners of the Brookford Mills at Brookford, Catawba County, have spent some money in building a sample road in their vicinity—this to serve as an object-lesson to the community. This was the first mile of sand-clay road built in Catawba County, and it is expected that it will inaugurate an era of good roads for this county. Much enthusiasm has been awakened in the county during the year over the use of the split-log drag. It is to be hoped that all the townships of this county will see the necessity for good roads and issue the bonds necessary to finance their propositions. It would mean more to the farmers of the county than possibly any other one thing, and would relieve them of the very high tax they are now paying to bad roads.

#### CHATHAM COUNTY.

Number of miles of public road in county.....	600
Number of miles of unimproved road in county.....	600
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to the county because of unimproved roads..	\$125,925

This county is situated in the midst of the Piedmont section of the State, and is essentially an agricultural county. There are no large towns in the county and most of the farmers have long hauls in order to market their products. For this reason, if for no other, the county should endeavor to build a system of good roads, as such a system would mean not only an increase in the value of the farm lands, but would greatly increase the value of the farm products. During 1911 considerable agitation has been going on in this county for good roads, the newspapers of the county leading this agitation. The *Siler City Grit* advocated a bond issue. Matthews Township in Chatham County has had a number of meetings in the interest of better roads and con-

\*Each of these townships passed bond issues for \$50,000 (March, 1912).



siderable agitation has gone on in connection with the issuance of bonds. An act was passed which permitted the township to vote on the bonds when the signatures of one-fourth of the qualified voters of the township were secured to a petition to be presented to the county commissioners who would authorize an election. During the year the Geological Survey sent a road engineer to the county, who surveyed a new road from Pittsboro to Bynum.

It is believed that the sand-clay and gravel roads can be built to advantage in this county; and, while the clay is undoubtedly in excess of the sand, yet it can be hauled from sand beds or bottoms at a much less cost than macadam roads can be built.

#### CHEROKEE COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	12
Number of miles of unimproved road in county.....	388
Character of unimproved roads—Earth, stones, mud, and many steep grades.	
Annual loss to county because of unimproved roads.....	\$81,480

This county is located in the extreme southwest corner of the State, beyond the Blue Ridge Mountains, and it is penetrated by outlying spurs of the Unaka Mountains. There are no large towns in the county, but a number of small towns and villages, and a large proportion of the inhabitants of the county, whether farmers, fruit growers, miners, or lumbermen, have long hauls in order to get their products to the railroad. A system of well-constructed public roads would mean a large increase in its wealth. Some of the townships of Cherokee County realize this and have endeavored to build roads by the township system, which system is good as a substitute, but not to be considered when the roads can be built by the county as a whole.

Marble District of Murphy Township has issued \$150,000 worth of bonds for building macadam roads, \$50,000 of which is to be expended at once. Valleytown Township has also issued bonds for the construction of roads.

It is believed that the sand-clay road could be constructed to good advantage in certain portions of the county where sand is accessible. The county is now paying a large debt to bad roads, and it would be well if the whole county could have a bond issue or by some other means raise the money necessary to construct a system of roads throughout the county at large.

## CHOWAN COUNTY.

Number of miles of public road in county.....	185
Number of miles of improved road in county.....	1
Number of miles of unimproved road in county.....	184
Character of unimproved roads—Sand (wet and dry).	
Annual loss to county because of unimproved roads.....	\$54,232

A sample of sand-clay road of one mile was built in Chowan County under the supervision of an engineer from the United States Office of Public Roads. This is the only mile of improved road constructed in the county to date. At a meeting held in Edenton in the early part of August an address was made by the State Geologist and the Chowan County Good Roads Association was organized. With the exception of this, no further interest has been shown in road improvement in this county. The county is situated in the extreme eastern part of the State in the Coastal Plain region. While it has plenty of sand and clay, yet they are not of the right texture to make the best sand-clay roads. It is believed that shell roads can be constructed to better advantage in this county.

## CLAY COUNTY.

Number of miles of public road in county.....	160
Number of miles of unimproved road in county.....	160
Character of unimproved roads—Earth, with ruts and mud, rocks, and steep grades.	
Annual loss to county because of unimproved roads.....	\$56,000

Very little interest has been shown in improved roads in Clay County to date. The Legislature of 1911 authorized a bond issue of \$8,000 for this county to be used in building a road from Hayesville to intersect with a road from Cherokee County. Clay County is situated in the extreme southwestern portion of the State, and is a small county with no large towns. The county could obtain, by a bond issue, a system of good roads, which would mean a great deal toward its up-building. It is believed that the sand-clay and gravel road could be built over a large portion of this county to advantage.

## CLEVELAND COUNTY.

Number of miles of public road in county.....	600*
Number of miles of improved road in county.....	28
Number of miles of unimproved road in county.....	572
Character of unimproved roads—Earth, with ruts, mud, stone, and some sand.	
Annual loss to county because of unimproved roads.....	\$120,120



Situated in the western portion of the State, Cleveland lies just to the east of the Blue Ridge Mountains. It may be regarded as one of the westernmost counties of the Piedmont section. The county is thickly populated, having two towns of considerable size and many small villages. A great many of the more progressive citizens of Cleveland County have realized the necessity for good roads, and have endeavored to secure such legislation as will enable them to build better roads. At an election held in Cleveland County, a bond issue failed to carry for the entire county. The matter was then taken up by townships. No. 6 Township, which contains the town of Shelby, voted \$100,000 in bonds in 1909. Work began on the roads of this township in 1910. A letter from Mr. L. A. Gettys regarding the road work in this township states:

"We are not building any macadam roads, but we think we are building a superior road. We grade with mules, and convict labor is surfacing the road with the topsoil taken from our fields. This topsoil is composed of some gravel, iron ore, and other hard pebbles, which bond well with our loam and clay. It makes a fine road, perfectly smooth, when a good grade of soil is used. In the absence of a good soil, we build a sand-clay road; but it is not nearly so good as the other."

No. 4 Township has voted \$25,000 in bonds and sold them. During 1911 they began operations at Kings Mountain and will build soil-surfaced and sand-clay roads.

No. 9 Township voted for bonds, but they failed to carry.

The county has ten townships in all; none of the others, however, have done any road work except in the old way; but the subject of good roads is being agitated in these other townships and it is expected that they will fall in line at an early date.

#### COLUMBUS COUNTY.

Number of miles of public road in county.....	700
Number of miles of improved road in county.....	2
Number of miles of unimproved road in county.....	698
Character of unimproved roads—Mostly sand.	
Annual loss to county because of unimproved roads....	\$205,727

Columbus County is situated in the extreme southeastern section of North Carolina in the Coastal Plain region. It has a large area and no large towns. The county is more or less swampy, very level and sandy. It is principally an agricultural county, with considerable lumbering. Both these occupations require good roads for the transportation of their products. A great deal of interest has been stirred up in Columbus County for good roads, and many meetings have been

held, some of which have been addressed by the State Geologist and engineers of the Geological Survey. The Columbus County Good Roads Association was organized in 1910. No road work of any moment, however, has been accomplished in the county. The mayor of Whiteville has had signboards placed on all the public roads leading out of the town. Many citizens of the county have tried to stimulate interest in road work by making subscriptions toward the cause. This county could well afford to issue bonds, even to the extent of \$300,000 or \$400,000, if by doing so it could do away with the enormous tax it is now annually paying to bad roads. The county will never be able to reach its full value until a system of good roads is provided.

#### CRAVEN COUNTY.

Number of miles of public road in county.....	350
Number of miles of improved road in county.....	17
Number of miles of unimproved road in county.....	333
Character of unimproved roads—Mostly sand.	
Annual loss to county because of unimproved roads.....	\$98,184

Craven County is another one of the easterly Coastal Plain counties, and is the second one in the tier of counties through which the Central Highway passes. A great deal of interest was awakened in this county, particularly in connection with the building of this State Highway. Meetings were held at various places in the county during July. A number of towns and individuals in Craven County have pledged themselves for money and labor in connection with the rebuilding of certain roads leading from New Bern to points in Beaufort County; but aside from what has been done on the Central Highway, the county has not made any advance steps in road building during the past year. Craven County could undoubtedly obtain a good system of sand-clay roads by the issuance of \$200,000 to \$300,000 worth of bonds which could be easily supported and retired by the county, without any increase of taxation.

#### CUMBERLAND COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	25
Number of miles of unimproved road in county.....	375
Character of unimproved roads—Earth, with ruts and mud, and considerable sand.	
Annual loss to county because of unimproved roads.....	\$78,750

This county is located within the Coastal Plain area, but closely bordering on the Piedmont section. It is well supplied with both sand and clay, so that the building of sand-clay roads within the county



should be comparatively an easy proposition. Cumberland contains one large town, the city of Fayetteville, and for this reason could easily handle a bond issue. Much agitation has been going on in the county for good roads, and the Cumberland County Good Roads Association has been very active in this movement. The General Assembly of 1911 passed an act authorizing an election for a \$200,000 bond issue. A county tax of 15 cents on the property and 45 cents on the poll was authorized for Cumberland County, to be levied until 1918. Provision was also made for any township so desiring to levy a special tax of 20 cents on property for road building. It is expected that the election on the bond issue will be called early in 1912. During the latter part of the year many good roads meetings were held at various places in the county in the interest of the proposed bond issue. Good roads clubs have been organized in various townships and precincts.

## CURRITUCK COUNTY.

Number of miles of public road in county.....	140
Number of miles of improved road in county.....	$\frac{3}{4}$
Number of miles of unimproved road in county.....	139 $\frac{1}{4}$
Character of unimproved roads—Sand.	
Annual loss to county because of unimproved roads.....	\$41,041

Currituck County is located in the extreme northeastern section of the State bordering on the Atlantic Ocean. It is, therefore, one of the Coastal Plain counties, and is overrun with quantities of sand, mostly ocean sand. A number of the members of the Currituck County Good Roads Association became interested in building a sample of sand-clay road, which was done under the supervision of a Government engineer. This stretch of three-quarters of a mile was built by private subscription, and it has proven most satisfactory. Private subscriptions are being raised to build samples of this kind of road in various parts of the county. Agitation is also going on in favor of a bond issue. It would not take a very large bond issue to construct a system of good roads for Currituck County, and the county would be more than justified in resorting to this means of securing a first-class system of sand-clay roads.

## DARE COUNTY.

Number of miles of public road in county.....	100
Number of miles of unimproved road in county.....	100
Character of unimproved roads—Sand.	
Annual loss to county because of unimproved roads.....	\$29,474

Little interest has been shown in road building in Dare County. The county is composed of one large strip connected with the mainland,

of Roanoke Island, and of a long stretch of sand banks between the sounds and the Atlantic Ocean. The larger portion of the county, which connects with the mainland, is but sparsely settled. Roanoke Island is more thickly settled than any other portion of the county, and it is believed that sand-clay roads could be built on this island to advantage, but the cost will be greater than in many other sections of the State on account of the scarcity of clay.

#### DAVIDSON COUNTY.

Number of miles of public road in county.....	700
Number of miles of improved road in county.....	7
Number of miles of unimproved road in county.....	693
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads....	\$144,196

Situated in the middle of the Piedmont section of North Carolina, Davidson is one of our principal agricultural counties. It contains numerous small towns, and two rather large and enterprising manufacturing towns. Her system of public roads, however, is notably poor as a general proposition, and the bad roads of this county have been given considerable advertisement by the travelers along the National Highway, which highway passes through this county, as does also the Central Highway. Only one township, Lexington, in Davidson County has actively awakened to the necessity for good roads to the extent of being willing to raise the funds with which to build them. This township has a bond issue, and has built a number of miles of good road. The good roads enthusiasts of the county at large, however, are doing a great deal toward awakening the people of the county to the necessity for improved roads.

On May 30th five townships of this county voted on a special tax for good roads. Alleghany Township was the only one, however, which carried this election. In October, 1911, Boone Township voted a special tax of \$1,000 for road building, and the county commissioners gave them \$325 for the same purpose.

Davidson is another county that can ill afford to continue with her present system of roads.

#### DAVIE COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	3
Number of miles of unimproved road in county.....	397
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$83,308

Just to the west of and bordering on Davidson County is the small county of Davie. The conditions of each, however, with respect to road



building are very similar. During the year 1911, while little actual road building was accomplished in the county, considerable interest was awakened for better roads by good road advocates in the county, as well as men from adjoining counties, who went into Davie and assisted at meetings in favor of better roads. Jerusalem Township has organized a Township Good Roads Association and has shown considerable activity in road building. The movement has also been stimulated by the offer of Mr. William R. Craig of New York, who owns a hunting lodge in this township, to bear half the expense of building three miles of sand-clay road in the township.

In October, 1911, a county Good Roads Association was organized.

Davie County could well afford to raise the money necessary to construct a system of good sand-clay roads throughout the county, and it is hoped that the whole county will be made to see the necessity for such a step.

#### DUPLIN COUNTY.

Number of miles of public road in county.....	800
Number of miles of unimproved road in county.....	800
Character of unimproved roads—Sand and earth.	
Annual loss to county because of unimproved roads.....	\$167,900

Duplin County is located in the Coastal Plain region, and is not so thickly populated as some of the adjoining counties; but it is very much alive to the necessity for good roads. During February of 1911, a County Good Roads Association was organized, which has been very active in connection with the awakening of a strong interest for better roads throughout the county. On May 9th, Warsaw Township voted a \$20,000 bond issue. In August a good roads meeting was held at Wallace and the Island Creek Good Roads Association was organized; and in October of 1911, Island Creek and Rockfish townships voted a \$30,000 bond issue. Rose Hill Township also carried a bond issue for \$10,000. While the township system of issuing bonds is not the best system to inaugurate, still, if all the townships will not work together for the whole county, it is well for the more progressive townships to take care of their own interests on the principle that half a loaf is better than no loaf.

#### DURHAM COUNTY.

Number of miles of public road in county.....	600
Number of miles of improved road in county.....	122
Number of miles of unimproved road in county.....	478
Character of unimproved roads—Earth, with ruts and mud, some sand.	
Annual loss to county because of unimproved roads.....	\$100,320

Durham County is located in the midst of the Piedmont section of North Carolina, and is an agricultural county. It contains the town of Durham, a large manufacturing center, which is the home of the American Tobacco Company. The amount of money raised from taxes for road purposes is sufficient to construct a certain mileage of improved road each year, but is not sufficient to give the county a system of improved roads within a reasonable time and at the same time maintain the roads which have already been built. The county has already built a number of miles of macadam, but because these have not been maintained, they have retrograded, and it is more than probable that a large proportion of them will have to be entirely resurfaced within a short time. It is poor policy to expend a great deal of money for the construction of roads, no matter what the surfacing material used, and not constantly maintain them. Durham County could issue a certain amount of bonds, and construct sand-clay roads throughout the entire county, and use her tax money for paying interest on the bonds, for creating a sinking fund to retire the bonds and at the same time have sufficient left to maintain her surfaced roads in first-class condition.

## EDGECOMBE COUNTY.

Number of miles of public road in county.....	750
Number of miles of improved road in county.....	8
Number of miles of unimproved road in county.....	742
Character of unimproved roads—Earth, with ruts and mud and considerable sand.	
Annual loss to county because of unimproved roads.....	\$174,396

Edgecombe County is another one of the Coastal Plain counties which is supplied with sand and clay in sufficient quantities to warrant its building sand-clay roads. Not very much interest, however, has been taken in the county in the improvement of its roads, and a letter from Mr. J. W. Martin of Tarboro, the road superintendent of the county, states that the road work in Edgecombe County is done in such a desultory way it is impossible to accomplish any permanent results. He states that there is a good deal of road talk in the county, but that the people do not seem ready to pay for them and do not realize what it costs to build roads. Whitakers Township in Edgecombe County has formed a road district and wants to build sand-clay roads. Edgecombe already has a road tax of 27 cents, the proceeds from which would undoubtedly be sufficient to maintain and retire a bond issue of sufficient magnitude to build a good system of sand-clay roads over the entire county.



## FORSYTH COUNTY.

Number of miles of public road in county.....	800
Number of miles of improved road in county.....	89
Number of miles of unimproved road in county.....	711
Character of unimproved roads in the county—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$149,221

Few counties in the State have taken a more active stand for good roads in the past few years than has Forsyth. The most progressive step yet taken by the county, however, was the employment of Mr. W. L. Spoon as the county highway engineer. The county had been building macadam roads without the services of a highway engineer, with the result that the price of the macadam was very high and the roads were not always satisfactory. Realizing that road work in Forsyth County must be placed on a different basis, an act was passed by the General Assembly of 1911 providing for the construction and keeping in repair the public roads of Forsyth County. At a meeting held in Winston-Salem, February 12, it was resolved that the directors of the Forsyth County Good Roads Association, in conjunction with the good roads committee of the Board of Trade, be empowered to select five men from the county to act as a Highway Commission. These highway commissioners were to hold office only in the event that a bond issue was voted. In case the bond issue was not voted, the county commissioners were to conduct the road business. Considerable agitation has been carried on during the year for a \$750,000 bond issue.

Since Mr. Spoon began his work in Forsyth County, he has built an experimental stretch of sand-clay road, and it is his opinion, after the severe test of the recent winter, 1911-12, that this road could be built to advantage in many portions of the county. Before the employment of the highway engineer, it was thought in Forsyth County that the macadam was the only feasible road for the county, and this was costing the county a very high rate per mile.

Much agitation has been aroused in Winston-Salem over a road connecting this city with High Point, and about \$5,000 has been raised by private subscription for constructing this road.

While Forsyth County has a large mileage of unimproved roads which are still costing the citizens of the county a great deal of money, yet it is believed that this county has taken the right step to overcome this handicap, and that it will not be many years before there will be a splendid system of good roads in every section of the county.

## FRANKLIN COUNTY.

Number of miles of public road in county.....	500
Number of miles of improved road in county.....	250
Number of miles of unimproved road in county.....	250
Character of unimproved roads—Earth, with ruts and mud and considerable sand.	
Annual loss to county because of unimproved roads.....	\$32,500

Lying on the border-line between the Coastal Plain region and the Piedmont section of the State, Franklin County is well supplied with road-building material, particularly for sand-clay roads, having an abundance of good sand and clay, and it has already been demonstrated in one of the townships in this county that this road can be built to great advantage. Three townships in Franklin County—Franklinton, Louisburg, and Youngsville—have issued bonds to the extent of \$110,000. These townships have acted very wisely and employed a road engineer to locate and build their roads, with the result that they have magnificent sand-clay roads which are an example to the rest of the State. The bond issue for Louisburg Township was voted during 1911, and the work in this township is only under way; but in Franklinton Township a considerable mileage has been constructed and has given most splendid satisfaction to the people of the township. To show what can be done when a bond issue is handled by a competent road engineer, the following summary of the road situation in Franklinton Township will be of interest:

"Franklinton Township shows that out of a \$40,000 bond issue about 50 miles of good road and 11 bridges have been constructed, and when the full 70 miles of road in the township are finished there will still be some money left from the bond issue. The roads are constructed of clay and gravel on a grade nowhere exceeding 4 per cent."

It is believed that the other townships in the county will follow the example of these three, and that Franklin County will indeed be out of the ruts of unprogressiveness.

## GASTON COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	89
Number of miles of unimproved road in county.....	311
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$65,271

Gaston County is located in the southern part of the State in the western portion of the Piedmont section. It is very well supplied with road-building materials. This was one of the first counties to vote a



bond issue for good roads, and in 1905 \$100,000 of this bond issue was sold and in 1908 the remaining \$200,000 was disposed of. Macadam roads were built with this bond issue and only 85 miles were constructed. The mistake made in Gaston County was similar to that made in Alamance County, in not employing a road engineer to take charge of the road work of the county. Four miles of sand-clay road have been built—three within the past year—and this sand-clay road shows that it would be a better proposition for Gaston to build this cheaper road throughout the greater portion of the county. Gaston still has a considerable mileage of unimproved roads; and while she has the old bond issue on her hands with a rather limited mileage of roads to show for it, yet it is believed that if she will raise the funds necessary to sand-clay the roads in the balance of the county there will be no cause for regret.

## GATES COUNTY.

Number of miles of public road in county.....	300
Number of miles of unimproved road in county.....	300
Character of unimproved roads—Earth, with ruts and mud and considerable sand.	
Annual loss to county because of unimproved roads.....	\$63,000

Gates County is another one of the Coastal Plain counties in which no road work has been carried on. It is located along the northern border of the State and is well supplied with sand, and should be able to get sufficient clay to build a system of sand-clay roads at a comparatively small cost. In August of 1911 the Gates County Good Roads Association was organized, which has been doing what it could to foster an interest in improved roads in the county.

## GRAHAM COUNTY.

Number of miles of public road in county.....	250
Number of miles of unimproved road in county.....	250
Character of unimproved roads—Earth, with ruts and mud and steep grades.	
Annual loss to county because of unimproved roads.....	\$52,500

Located in the extreme western portion of the State in the midst of the Great Smoky and Unaka Mountains, Graham County, with a rather sparse population, has a difficult problem in connection with the improvements of its system of roads because of the steep grades which in most cases have to be overcome. Little interest has been shown to date in the improvement of roads in this county. The proposition of building roads in Graham County, however, is not a hopeless one, and it is expected that the people of this county will soon begin to agitate the question of good roads.

## GRANVILLE COUNTY.

Number of miles of public road in county.....	700
Number of miles of improved road in county.....	104
Number of miles of unimproved road in county.....	596
Character of unimproved roads—Earth, with ruts and mud with considerable sand.	
Annual loss to county because of unimproved roads.....	\$119,040

Granville is located in the Piedmont plateau region and is well supplied with sand and clay for road building. This county has issued bonds to the extent of \$120,000, part of them having been issued in 1903 and part in 1909. This money was spent in building sand-clay roads, with excellent results. The efficiency of the roads has been maintained by the use of the split-log drag during the past year and the authorities of the county have been greatly pleased with the way the roads have stood up during the recent severe winter. There is talk of another bond issue for the completion of a system of highways for the entire county. While there was considerable opposition to the first bond issue, there has been such a general feeling of satisfaction with regard to the roads which have been built that little opposition is anticipated when another bond issue is put before the county.

## GREENE COUNTY.

Number of miles of public road in county.....	400
Number of miles of unimproved road in county.....	400
Character of unimproved roads—Mostly sand and earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$117,895

Greene County is situated in the midst of the Coastal Plain region and should be very much interested in the securing of an improved system of public highways, because it is an agricultural county, and most of the farmers have long hauls before reaching the railroad. It is now paying an enormous tax to bad roads, and there is little chance of improvement in the near future.

## GUILFORD COUNTY.

Number of miles of public road in county.....	800
Number of miles of improved road in county.....	178
Number of miles of unimproved road in county.....	622
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$130,542

Few counties in the State have taken a more active part in road building than Guilford. Located in the midst of the Piedmont section of North Carolina, it contains two large cities, Greensboro and High



Point, and thickly populated rural communities. The county issued \$300,000 in bonds, which was expended in the construction of macadam roads from 1905-1909. These roads stood up well until the automobile came into its full swing, and now they are reported as going to pieces badly. The road from Greensboro to High Point was treated with bitulithic a year and a half ago with good results. The authorities who have had charge of the road building in Guilford County failed to realize the great necessity for maintenance, and many of their most excellent macadam roads have begun to go to pieces. They are now beginning, however, to realize the necessity for constant maintenance of these roads, and also for building a cheaper road in the county at large. The sand-clay road can be built in this county to advantage, and it is believed that when they once begin to build and maintain this kind of road the whole of the county will be a network of good roads, and that every section of the county will then reap the benefits now accruing to those portions through which good roads pass.

## HALIFAX COUNTY.

Number of miles of public road in county.....	750
Number of miles of improved road in county.....	33
Number of miles of unimproved road in county.....	717
Character of unimproved roads—Earth, with ruts and mud, and some sand.	
Annual loss to county because of unimproved roads.....	\$150,480

Halifax is a large county, situated along the western border of the Coastal Plain region. It has no large cities, but a number of small towns and villages, and is essentially an agricultural county. There has been considerable agitation in the county for better roads, and a County Good Roads Association organized. At a meeting of this association, held in August, the State Geologist was present and earnestly advocated the employment by the county of a competent road engineer. There has also been considerable agitation for a \$300,000 bond issue.

This county could undoubtedly obtain a good system of sand-clay roads at comparatively small cost, and it would certainly be good policy for the county to issue the bonds and get rid of the enormous tax she is now paying annually to bad roads.

## HARNETT COUNTY.

Number of miles of public road in county.....	800
Number of miles of improved road in county.....	25
Number of miles of unimproved road in county.....	775
Character of unimproved roads—Earth, with ruts and mud; considerable sand.	
Annual loss to county because of unimproved roads.....	\$162,750

Lying on the border-line between the Coastal Plain and Piedmont plateau, Harnett County is in that region which is abundantly supplied by nature with materials suitable for building sand-clay roads. An act was passed by the Legislature of 1911, authorizing an election for a \$100,000 bond issue. In case the bonds should fail to pass, the county commissioners were ordered to levy a tax of 75 cents on the poll for use on the public roads. Two townships, Lillington and Averagesboro, have a special tax for roads and are doing some work toward the permanent improvement of their roads. The bond issue scheduled to be voted upon in December was postponed to some time during the early part of 1912.

#### HAYWOOD COUNTY.

Number of miles of public road in county.....	200
Number of miles of improved road in county.....	25
Number of miles of unimproved road in county.....	175
Character of unimproved roads—Earth, with ruts and mud, rocks and steep grades.	
Annual loss to county because of unimproved roads.....	\$36,750

Haywood County is situated in the extreme western portion of the State in the midst of the Great Smoky and Blue Ridge mountains. Despite the ruggedness of the country, Haywood has done a great deal more with her roads than some of the counties whose topography would permit of an easier proposition in road construction. The Haywood County Good Roads Association has been quite active in promoting the cause of good roads, and many private individuals and companies have contributed toward the cause. The Methodist Chautauqua, located near Waynesville, is building from 25 to 30 miles of road in connection with their grounds. This road will serve as an object-lesson to the county at large, and will be of considerable service to the county. The people of Haywood County have offered to put in good shape a road from the Buncombe County line to the Tennessee line via Waynesville, if this could be routed as part of the Central Highway. In connection with this Central Highway idea, a great deal of agitation has been going on in the county for better roads.

#### HENDERSON COUNTY.

Number of miles of public road in county.....	800
Number of miles of improved road in county.....	15
Number of miles of unimproved road in county.....	785
Character of unimproved roads—Earth, with ruts and mud, rocks and steep grades.	
Annual loss to county because of unimproved roads.....	\$164,272



This county is situated in the mountain region and is along the southern border of the State, bordering on South Carolina. Much agitation has been going on in the county in connection with the building of the Charlotte-Asheville, Asheville-Greenville, and Asheville-Spartanburg highways, this latter highway being a spur of the New York-Atlanta Highway. A number of clubs, such as the Kanuga Club, etc., have established colonies in different portions of Henderson County, and in connection with these have built excellent sand-clay roads. Some Florida capitalists will spend \$100,000 in developing Sugar Loaf Mountain as an automobile club. During the latter part of the year there was considerable talk in the county of having the county commissioners issue \$100,000 in bonds for road work. The county chain-gang has been at work on the road between Hendersonville and the South Carolina line, forming a link of the Asheville-Greenville and Asheville-Spartanburg highways; and it is reported that this stretch of road is completed.

## HERTFORD COUNTY.

Number of miles of public road in county.....	600
Number of miles of unimproved road in county.....	600
Character of unimproved roads—Mostly sand.	
Annual loss to county because of unimproved roads.....	\$176,842

Hertford County is another one of the Coastal Plain counties, and while little road work of any note has been done, there has been considerable activity in the county for better roads. Several of the townships in Hertford County have a special tax for road building; but the taxes are small and practically all the money is expended in repairing the old dirt roads, which, of course, means practically no road improvement of permanent worth. A meeting was held at Winton during August, which was addressed by the State Geologist, and a County Good Roads Association was organized. Hertford County should be able to build first-class sand-clay roads, and the solution of her problem is the issuance of bonds for building such a system of roads.

## HOKE COUNTY.

Number of miles of public road in county.....	200
Number of miles of unimproved road in county.....	200
Character of unimproved roads—Earth, with ruts, mud, and some sand.	
Annual loss to county because of unimproved roads.....	\$42,000

This is a new county, established by the Legislature of 1911, and is located in the western portion of the Coastal Plain region, being formed from portions of Cumberland and Robeson counties. Among the first

acts of the county commissioners of the county was to set apart a tax of 15 cents out of the general tax for public roads, and 45 cents of the poll. Sand-clay roads are to be built in the county and permanent road signs erected. In June, 1911, the commissioners of this county decided to issue \$50,000 in bonds for permanent road improvement. From the beginning made, it looks as though Hoke County will be one of the most progressive counties in the State in permanent road work, which is indicative of general progress.

## HYDE COUNTY.

Number of miles of public road in county.....	250
Number of miles of unimproved road in county.....	250
Character of unimproved roads—Mostly sand and some earth roads (black mud).	
Annual loss to county because of unimproved roads.....	\$52,500

Hyde County is situated in the extreme eastern portion of the State, bordering on Pamlico Sound, being much penetrated by lakes, rivers, bays, etc. The land is extremely swampy in character and the county is sparsely populated. The soil is exceedingly fertile and agriculture is the leading industry. The proposition of building roads in Hyde County is rather a difficult one, and it may be that the shell road, where shells can be obtained, would be the most feasible road to build. No great amount of interest has been shown in this county in the improvement of its public roads. In June of 1911, however, the county commissioners arranged to build five miles of sand-clay, one mile in each township, by public subscription. In connection with this, the county bought \$1,000 worth of machinery.

## IREDELL COUNTY.

Number of miles of public road in county.....	375
Number of miles of improved road in county.....	36
Number of miles of unimproved road in county.....	339
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$71,148

Iredell County is located in the Piedmont section of the State, and contains two rather large towns, Statesville and Mooresville. The county has a large rural population, and is one of the best agricultural counties in the State. This county took a most progressive step, when on May 9th the county voted by a large majority a bond issue of \$400,000. The next important step taken by this county was the employment of a competent road engineer to take charge of its road work; and the engineer employed was Mr. W. S. Fallis, who is one of the



highway engineers of the North Carolina Geological and Economic Survey. Because Iredell County has voted for bonds as a county, and is building her roads over the whole county as a unit, and because she has placed her road work in the hands of a most competent man, it is believed that her road work has been begun on a better and more thorough basis than that of any other county in the State. The sand-clay road will be the principal type built in the county.

## JACKSON COUNTY.

Number of miles of public road in county.....	400
Number of miles of unimproved road in county.....	400
Character of unimproved roads—Earth, with ruts, mud, rocks, and steep grades.	
Annual loss to county because of unimproved roads.....	\$84,000

Jackson County is situated in the southwestern portion of the State in the heart of the Blue Ridge Mountains. The principal occupations of the county are lumbering, mining, and agriculture; and, because of this, there should be a system of improved roads so that the people could market their products. No permanent good roads have been built in this county, and, to date, there has been little sentiment for good roads. It was reported that in June of 1911 the County Commissioners of Jackson County expected to levy a special road tax for Sylva, Webster, and Cullowhee townships; and also a county tax for building good roads from Sylva to Webster, and thence, from some point on the road near the present forks of the road, towards the southern end of the county.

## JOHNSTON COUNTY.

Number of miles of public road in county.....	800
Number of miles of improved road in county.....	115
Number of miles of unimproved road in county.....	685
Character of unimproved roads—Earth, with ruts, mud, and sand.	
Annual loss to county because of unimproved roads.....	\$155,550

Johnston is another of the counties bordering between the Piedmont plateau and Coastal Plain regions of the State, and is well supplied with sand and clay for road building. It is a county of extensive area and agriculture is the principal industry. It is therefore especially desirable that the county secure a system of well-built roads in every section. During the past year considerable interest has been shown in this county in connection with the improvement of roads. The Legislature of 1911 passed an act providing for an election on a bond issue, and, in case this should not pass, the bill provides that any township

can apply for an election and vote a special tax of 33 $\frac{1}{3}$  cents on the \$100 worth of property. If this carries, the old law is to become void. Wilson's Mills and Wilders townships have voted this tax, and it is expected that the other townships will follow suit. This is one of the counties through which the Central Highway passes, and much interest has been awakened in better roads because of the meetings held in connection with making provisions for building this highway. A number of meetings were held in the county during the year and the State Geologist made several addresses. A County Good Roads Association was organized, and also a Township Good Roads Association in Benson Township. It is believed that if Johnston County will vote a bond issue it will very soon arrive at the solution of the problem of a system of good roads all over the county.

## JONES COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	4
Number of miles of unimproved road in county.....	396
Character of unimproved roads—Mostly sand.	
Annual loss to county because of unimproved roads.....	\$83,160

Jones County is situated in the Coastal Plain region, and while it is not a very thickly settled county, yet, because of its large agricultural and lumbering interests, it would be to its advantage to have a good system of public roads throughout the county. The Central Highway may pass through the northern portion of this county, and some interest was awakened in road improvement in connection with this highway. The Jones County Good Roads Association was organized in May, but so far as is known little active work has been accomplished by this association. It is hoped that the people of Jones County will become more active for improved roads, as it is a county which cannot afford to continue with the same system of roads which it now has.

## LEE COUNTY.

Number of miles of public road in county.....	300
Number of miles of improved road in county.....	1
Number of miles of unimproved road in county.....	299
Character of unimproved roads—Earth, with ruts, and mud, and sand.	
Annual loss to county because of unimproved roads.....	\$64,790

Few counties in the State are better supplied with excellent materials for the construction of sand-clay roads than is Lee. Situated along the border-line of the Coastal Plain region, she has quantities of good sand and also clay, and there is no reason why it cannot obtain a system of



splendid roads at a very reasonable price. Much agitation has been going on in Lee County for better roads, and the county will vote on a \$100,000 bond issue in 1912,\* and there is every prospect that it will carry. The Lee County Good Roads Association was organized in April of 1911 and has done much active work toward creating a sentiment in favor of the bond issue.

## LENOIR COUNTY. -

Number of miles of public road in county.....	600
Number of miles of improved road in county.....	15
Number of miles of unimproved road in county.....	585
Character of unimproved roads—Earth, with ruts, mud, and sand.	
Annual loss to county because of unimproved roads.....	\$122,850

Lenoir County is situated in the eastern part of the State in the Coastal Plain region, and is traversed by the Central Highway. In connection with this highway much interest has been awakened in good roads. Meetings were held during the year in various parts of the county and a County Good Roads Association was organized. The county commissioners appropriated the \$50 per mile for work on the Central Highway. The Lenoir County Good Roads Association met at Kinston on August 19, 1911, and passed the following resolutions:

"Whereas good roads are necessary in the development of any county, and more especially in an agricultural one; and whereas it is very desirable that the roads of our county be made good and serviceable three hundred and sixty-five days in the year: therefore, be it

*"Resolved*, (1) That the Good Roads Association of Lenoir County indorse the movement to build the State Central Highway through Lenoir County.

*"Resolved*, (2) That all the public roads in the county should be improved in accordance with the amount of travel thereon and to the end that a good and improved road be within the reach of every citizen, however humble or remote, and that this association pledge itself to work to accomplish this purpose.

*"Resolved*, (3) That we indorse the efforts of the county commissioners to erect suitable bridges and culverts on the county roads.

*"Resolved*, (4) That it is the opinion of the Good Roads Association that our roads should be made without going into debt, at this time, by a bond issue or otherwise; and to this end,

*"Resolved*, (5) That we heartily indorse the improvement of roads with the regular road funds, supplemented by private contributions in money, work, or material, believing, as we do, that the burden shall fall in proportion to benefits received. This voluntary system appeals to patriotism in the highest sense, and we earnestly beg that each citizen meet the fullest measure of his responsibility in this momentous effort to build up our good county. There should be no shirkers; every man should do his duty.

\*Bond issue was passed January, 1912.

"*Resolved*, (6) That we urge our people to make contributions, be it money, work, or material, promptly whenever requested by those leading in this effort, even if doing so means sacrifice; and we especially commend the citizens of Moseley Hall, Institute, Trent, and Contentnea Neck townships in taking the steps they have to improve their roads.

"*Resolved*, (7) That in order to put into effect these resolutions, that the week commencing September 4th and ending September 9th, inclusive, be set aside as the Good Roads Week, and that this meeting appoint the necessary committees to carry into effect the objects and aims of these resolutions."

While small stretches of improved road can be built by private subscription, yet it is not possible to obtain a system of public highways by such a method, and, while the result of such sentiment as is embodied in the above resolutions may lead to the awakening of enthusiasm for better roads, yet the method suggested for financing the proposition is not a feasible one. The best plan for a county like Lenoir to get a system of public highways is by the issuance of from three to four hundred thousand dollars worth of bonds and the gradual retirement of these bonds by a special tax.

#### LINCOLN COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	1½
Number of miles of unimproved road in county.....	398½
Character of unimproved roads—Earth, with ruts and mud and stones.	
Annual loss to county because of unimproved roads....	\$83,885

Lincoln County is located along the western portion of the Piedmont section of North Carolina. It is a small county and rather thickly populated, with a number of small towns. But little interest has been manifested in this county in improved roads to date. Lincoln Township raised some money to build a sample stretch of sand-clay road, and this stretch of road was located by one of the engineers of the Geological Survey. Lincoln County has shown too much progress along other lines to continue unprogressive in the matter of public road building.

#### MCDOWELL COUNTY.

Number of miles of public road in county.....	350
Number of miles of improved road in county.....	6
Number of miles of unimproved road in county.....	344
Character of unimproved roads—Earth, with ruts, and mud, and stones, and steep grades.	
Annual loss to county because of unimproved roads.....	\$92,197

McDowell County is located in the western portion of the State, along the eastern slopes of the Blue Ridge Mountains, the western por-



tion of the county being bounded by the crest of the Blue Ridge. The county is traversed by the Central Highway, and considerable interest has been aroused in the county in good roads in connection with this highway. An act was passed by the General Assembly of 1911 for the improvement of roads in the county and a special act for the improvement of roads in Marion Township. A Township Good Roads Association was organized in Old Fort Township in connection with the Central Highway. During the summer of 1911 some private parties cut a horseback trail from Graphiteville to Mount Mitchell. A law passed by the Legislature for the county puts the entire road construction and the repairing of the roads of McDowell in the hands of three road commissioners in each township, and authorizes the county commissioners to levy 20 cents on the \$100 worth of property for road improvement in the various townships in the county. There has been much dissatisfaction with the results obtained in this county from the present method of working the roads and spending the money, but it is the same old problem that you will find in most of the other counties of the State—having men in charge of road construction who are not trained road builders.

## MACON COUNTY.

Number of miles of public road in county.....	750
Number of miles of unimproved road in county.....	750
Character of unimproved roads—Earth, with ruts, and mud, and steep grades.	
Annual loss to county because of unimproved roads.....	\$157,500

Located in the southwestern corner of the State, Macon is traversed by the Blue Ridge Mountains. It has a large area and varied industries, such as mining, lumbering, and agriculture. The county is well supplied with natural resources and only needs to solve the great problem of transportation of its products to market. Practically nothing has been done in this county in road improvement, and it is hoped that the citizens of Macon will soon realize the large annual loss sustained by the county because of its present system of exceedingly bad roads. An act was passed by the Legislature of 1911 to improve the public roads of Macon County. This provides for a special tax of from 25 cents to 40 cents on property, a labor tax of four days between the ages of 21 and 45 years, and lumbermen and loggers pay a special license tax.

## MADISON COUNTY.

Number of miles of public road in county.....	300
Number of miles of unimproved road in county.....	300
Character of unimproved roads—Earth with ruts, mud, and steep grades.	
Annual loss to county because of unimproved roads.....	\$63,000

Madison County is located in the extreme western portion of the State, and is traversed by the Great Smoky Mountains. The topography of the county is very rugged, and the roads are very bad. One branch of the Central Highway is to go through this county, terminating at Paint Rock on the Tennessee line. In connection with the Central Highway considerable interest has been awakened in Madison in improved roads, and in March of 1911 the Madison County Good Roads Association was organized. In June, 1911, Mars Hill Township in Madison County voted a \$10,000 bond issue for better roads. A general act was passed by the Legislature for Madison County, providing for the holding of an election for bonds in any township upon a petition from such township. Madison County also has a law which enables the county commissioners to levy a tax of 50 cents on the \$100 valuation and \$1.50 on the poll. A number of the other townships in Madison County have called elections to vote upon bond issues. It is believed that the people of this county are thoroughly aroused to the necessity for good roads, and that the sentiment will grow until the county has a good system of public roads.

## MARTIN COUNTY.

Number of miles of public road in county.....	425
Number of miles of improved road in county.....	7
Number of miles of unimproved road in county.....	418
Character of unimproved roads—Earth, with ruts and considerable sand.	
Annual loss to county because of unimproved roads.....	\$87,780

Martin County is located in the midst of the Coastal Plain region of the State. There has been a great deal of agitation during the past year in this county for good roads, and in March of 1911 Williamston Township voted a \$40,000 bond issue for good roads. Little work has been done outside of this township, but it is believed that the rest of the county will realize the importance of good roads and follow the lead of this township. The county has a Good Roads Association.

## MECKLENBURG COUNTY.

Number of miles of public road in county.....	850
Number of miles of improved road in county.....	320
Number of miles of unimproved road in county.....	530
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$118,580

Mecklenburg is a large county situated in the Piedmont section of North Carolina, along the southern border of the State. It has long been known as the banner county for good roads in North Carolina. It



was the first county to secure a progressive road law and the first county in the State to issue bonds for good roads. These bonds were issued a number of years ago; macadam roads were built, and have proved to be, despite the high cost of building, probably the best investment the county ever made. The authorities of the county are beginning to see the necessity for maintaining their surfaced roads and for extending the mileage of good roads into other parts of the county. There has been much talk of another bond issue. It is probable that the sand-clay road can be most profitably constructed, especially in the outlying portions of the county where traffic is not so heavy as in the immediate vicinity of Charlotte.

## MITCHELL COUNTY.

Number of miles of public road in county.....	500
Number of miles of unimproved road in county.....	500
Character of unimproved roads—Earth, with ruts, and rocks, and steep grades.	
Annual loss to county because of unimproved roads.....	\$105,000

Mitchell is another mountain county located in the extreme western portion of the State. The Crest of the Blue Ridge Highway goes through the southern portion of this county and has awakened considerable interest in the county in improved roads. The county is not very thickly populated, the principal occupations being mining and lumbering, with some farming. No road work of a permanent nature, however, has been done in the county. The Mitchell County Good Roads Association was organized in June of 1911, and it is hoped that through the work of this association considerable interest will be aroused in road improvement.

## MONTGOMERY COUNTY.

Number of miles of public road in county.....	300
Number of miles of improved road in county.....	20
Number of miles of unimproved road in county.....	280
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$58,765

Montgomery County is located in the Piedmont section of North Carolina and is essentially an agricultural county. It is, therefore, very necessary that the county have a good system of public highways, if it is to realize its fullest development. The county has a Good Roads Association which has done a good deal of work toward creating a sentiment for better roads. It has been estimated that sand-clay roads can be built in Montgomery County at a cost of from \$300 to \$500 a mile, and, even at the higher figure, it would only take a

\$200,000 bond issue to give the entire county a system of good public roads. At a meeting of the county commissioners in October it was ordered that an election be held the first Tuesday in January of 1912 to vote on a \$100,000 bond issue. Meetings have been held throughout the county at various times in the interest of this bond issue. There are a great many good roads enthusiasts in this county, and they have shown their interest in a very practical way by contributing labor, teams, and tools to improve the roads in their neighborhoods.

#### MOORE COUNTY.

Number of miles of public road in county.....	600
Number of miles of improved road in county.....	200
Number of miles of unimproved road in county.....	400
Character of unimproved roads—Mostly sand.	
Annual loss to county because of unimproved roads.....	\$117,895

Moore County stands out prominently among the counties of the State having no large towns as being one of the most progressive in matters of road building. Unable to obtain a bond issue for the county as a whole, it has taken it up by townships, and three townships—McNeills, Carthage, and Sandhills—have voted bonds for the construction of improved roads. In connection with McNeill's Township, the following clipping has been taken from one of the papers:

"McNeill's Township, Moore County, should be an object-lesson to the people of the whole South. Three years ago the township was noted for its abominable roads. To-day, according to the statement of J. R. McQueen, road supervisor, the township has nearly 70 miles of improved roads, money in the treasury to build more, money coming with the taxes soon due, and a sinking fund provided for the bond issue has already reduced the bonded debt incurred at the beginning of road-building period.

"When the township decided to try for good roads it was proposed to do the work with the taxes. This was sufficient to show what a good road signified. Then a bond issue of \$15,000 was voted. From that bond issue the present mileage has been constructed and \$2,000 of the debt has been paid from the funds accumulated in the sinking fund. The debt will be wiped out in a few years, eight or ten at the most, and the increased value in property will give an increase in taxes that will put the township on an entirely different plane."

Moore has a Good Roads Association which has done considerable work in connection with the good roads movement in that county. The county also owes a great deal to Mr. Leonard Tufts of Pinehurst, who has very generously assisted the county in connection with its roads by contributions and earnest advocacy, and has at all times been a very ardent supporter of good roads.



## NASH COUNTY.

Number of miles of public road in county.....	800
Number of miles of improved road in county.....	50
Number of miles of unimproved road in county.....	750
Character of unimproved roads—Earth, with ruts and mud, and some sand.	
Annual loss to county because of unimproved roads.....	\$177,500

Nash County is situated along the western border of the Coastal Plain region, and lies in that portion of the State which is well supplied with clay and sand for road building, and the most excellent type of sand-clay road can be built at comparatively small cost. A great deal of interest has been awakened in this county during the past year in improved roads. The following townships have voted bonds in Nash County during the year:

Castalia, \$15,000; Dry Wells, \$20,000; North Whitakers, \$20,000; South Whitakers, \$10,000.

Under an act of the General Assembly of 1911 a road tax was levied for the whole county. Meetings are being held in several portions of the county in hopes that the whole county will fall into line and have a system of good roads over the entire county.

## NEW HANOVER COUNTY.

Number of miles of public road in county.....	125
Number of miles of improved road in county.....	66
Number of miles of unimproved road in county.....	59
Character of unimproved roads—Sand.	
Annual loss to county because of unimproved roads.....	\$17,390

New Hanover is a small county located in the extreme southeastern portion of the State, bordering on the Atlantic Ocean. The city of Wilmington is located in this county, and, because of this, the county is able to build a certain mileage of improved road each year by means of its tax money for roads. A number of miles of shell road have been constructed in this county which have proved satisfactory, and a lime-stone has been obtained from Castle Hayne which has been used as a road surfacing material. During the year the county issued \$50,000 in bonds for the construction of a bridge across the Northeast Cape Fear connecting New Hanover and Pender counties.

## NORTHAMPTON COUNTY.

Number of miles of public road in county.....	675
Number of miles of unimproved road in county.....	675
Character of unimproved roads—Earth, with ruts and sand.	
Annual loss to county because of unimproved roads.....	\$141,750

Northampton County is located in the western edge of the Coastal Plain region and along the northern border of the State. It is in the general section which is well supplied with clay and sand suitable for building sand-clay roads, and there should be no trouble in securing a system of good roads for the county which would relieve it of the terrible burden it is now carrying in the way of bad roads. The county is a large one and is splendidly adapted to agriculture, which is all the more reason why it should have a good system of public roads. The General Assembly of 1911 passed a special act for Rich Square Township in Northampton County, and during the year this township voted \$30,000 in bonds for road improvement. The county has a Good Roads Association which has done considerable in the way of awakening interest in good roads. Much yet remains to be done, however.

#### ONSLOW COUNTY.

Number of miles of public road in county.....	350
Number of miles of unimproved road in county.....	350
Character of unimproved roads—Mostly sand, some earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$73,500

Onslow County is located in the extreme eastern portion of the State in the Coastal Plain region. It is mostly an agricultural county and with bad roads. There has been some agitation in Onslow County for good roads and in favor of a bond issue for \$100,000, but without results so far.

#### ORANGE COUNTY.

Number of miles of public road in county.....	300
Number of miles of improved road in county.....	20
Number of miles of unimproved road in county.....	276
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$57,926

Historically, Orange is one of the oldest counties in the State, and geographically it is located near the center of the State in the midst of the Piedmont section. The portions of the county which would have produced large towns were cut off, leaving the present Orange without large towns and with a none too numerous rural population. There has been little interest taken in improving the roads of the county except in Hillsboro and Chapel Hill townships. Hillsboro Township issued \$40,000 in bonds in 1908, which was expended in building macadam roads. The mistake was made by the township of having the roads located by an inexperienced man and built without the services of a



competent road engineer; consequently, a limited mileage was secured and portions of this were not well constructed. Chapel Hill Township has had a special act governing its road work, and the portion of the county road tax contributed by this township was expended by a special commission in the township. This was true also of Cedar Grove Township. The Legislature of 1911, however, passed an act authorizing the county to vote upon a \$250,000 bond issue, and, in case the bond issue passed, the special acts governing the different townships were to be repealed. This bond issue is to be voted upon early in 1912,\* and the prospects are that it will pass and that Orange will no longer be rated among the Rip Van Winkle counties of the State. With good roads in the county, the Durham markets will become readily accessible to the farmers from all sections of the county and the value of the farm lands will thereby be greatly increased.

## PAMLICO COUNTY.

Number of miles of public road in county.....	200
Number of miles of unimproved road in county.....	200
Character of unimproved roads—Sand.	
Annual loss to the county because of unimproved roads....	\$58,948

Pamlico is one of the extreme eastern counties of the State, being located in the Coastal Plain region. It borders on Pamlico Sound and is much broken up by rivers, lakes, inundations from the sound, etc. The whole county is very flat, sandy, and marshy; and the question of building improved roads in the county will, of course, present difficulties. There has been considerable agitation for some improvement in the present system of road building in this county. The Legislature of 1911 made provision for a special tax for roads in No. 3 Township. Provision was also made for the condemnation of marsh land for 20 feet on each side of any causeway of the county. In July of 1911 there was a meeting of the citizens of Arapahoe to discuss ways and means for improving the public roads. They decided to build one mile of sand-clay road adjacent to Arapahoe as a sample. This was to be built by contributions from the citizens living along the road. The idea was, if the road is successful, to work for a bond issue for building roads over the entire county.

## PASQUOTANK COUNTY.

Number of miles of public road in county.....	225
Number of miles of unimproved road in county.....	225
Character of unimproved roads—Sand.	
Annual loss to county because of unimproved roads.....	\$66,316

\*Bond issue for \$250,000 passed March, 1912.

Pasquotank is located in the northeastern portion of the State, bordering on the Albemarle Sound, being one of the Coastal Plain counties. The county is not large and has not a very extensive mileage of public road. It also contains one large city, Elizabeth City, and there should be no trouble at all in raising the funds necessary for building good roads throughout the county. There has been some agitation for good roads in the county and in August a meeting was held at Elizabeth City at which the Pasquotank County Good Roads Association was organized. The county has issued bonds for the construction of a steel bridge to connect Elizabeth City with Camden County. Considerable interest has also been aroused in this county over a highway to be constructed from Elizabeth City to Portsmouth, Virginia.

#### PENDER COUNTY.

Number of miles of public road in county.....	500
Number of miles of unimproved road in county.....	500
Character of unimproved roads—Mostly sand.	
Annual loss to county because of unimproved roads.....	\$147,369

Pender is a Coastal Plain county of rather extensive area. The county is swampy, with a very rich soil, and has splendid possibilities both from its soil and timber. With the drainage of portions of the swamp lands in the county and the construction of a good system of public roads, the county should become one of the richest in the State. There has been considerable agitation in the county for good roads and a County Good Roads Association has been organized. There is a great deal of talk in the county in behalf of a \$100,000 bond issue and it is expected that it will be put to a vote early in 1912. A number of good roads meetings have been held in the county at different times during the year in behalf of this bond issue.

#### PERQUIMANS COUNTY.

Number of miles of public road in county.....	325
Number of miles of unimproved road in county.....	325
Character of unimproved roads—Sand.	
Annual loss to county because of unimproved roads.....	\$95,790

Perquimans County is located in the Coastal Plain in the extreme eastern portion of the State, lying on the Albemarle Sound. The county is similar in its topography to that of Pasquotank and Chowan, which lie next to it on either side. Very little active work has been done in this county to create a sentiment for better roads and no road work of a permanent nature has been done. The Legislature of 1911 passed an act providing for a special tax for roads in this county, but



this tax is simply used to repair the roads as they now exist, and no permanent benefit is gained from its expenditure. There has been organized a County Good Roads Association.

## PERSON COUNTY.

Number of miles of public road in county.....	600
Number of miles of unimproved road in county.....	600
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$125,925

There are few counties in the State which would profit more by good roads than Person County. Situated in the Piedmont region, it is in the midst of one of the best tobacco raising sections of the State. The county is essentially an agricultural one and has no large towns, except Roxboro, which is a town of 2,800 population. By having a system of good roads the farmers could take advantage of the Durham and Danville markets, which would undoubtedly be to their great advantage. However, little effort has been made in the county to secure better roads; and, while there has been organized a County Good Roads Association and the local paper in Roxboro has advocated good roads strenuously, yet nothing of a permanent nature has been accomplished. There has been some agitation for a bond issue for building sand-clay roads, but no date has been fixed for holding such an election. The roads of this county are in practically the same condition that they were fifty years ago.

## PITT COUNTY.

Number of miles of public road in county.....	900
Number of miles of improved road in county.....	25
Number of miles of unimproved road in county.....	875
Character of unimproved roads—Earth, with ruts, mud, and some sand.	
Annual loss to county because of unimproved roads.....	\$183,750

Pitt County is situated in the midst of the Coastal Plain region and is another county whose chief industry is agriculture. It is a large county, rather thickly populated, and has an extensive mileage of public roads, most of which are in poor condition. There has been some agitation in the county for better roads, and the Legislature of 1911 passed an act relating to the improvement of the roads of Greenville Township. There is some talk in this township of a bond issue for \$50,000. The election for this, however, has not yet been called. There was a good deal of interest in the county aroused over the possibility of having a branch of the Central Highway come through the

county from Kinston, Lenoir County, to Maple-Cypress, a distance of 24 miles. In connection with this, a meeting was held in August, which was addressed by the State Geologist and at which the Pitt County Good Roads Association was organized.

#### POLK COUNTY.

Number of miles of public road in county.....	300
Number of miles of improved road in county.....	3
Number of miles of unimproved road in county.....	297
Character of unimproved roads—Earth, with ruts, mud, stones, and steep grades.	
Annual loss to county because of unimproved roads.....	\$62,370

Polk County is situated in the mountain region, along the eastern border of the Blue Ridge, bordering on South Carolina. A great deal of interest in good roads has been awakened in this county in connection with the agitation for building the Asheville-Greenville and the Charlotte-Asheville highways. The road from Tryon to the South Carolina line has been practically completed, and is from 30 to 40 feet wide; and also from Tryon to the Henderson County line. In September, 1911, there was a meeting at Columbus for good roads. It was decided at this meeting to circulate petitions throughout the county to ask the commissioners to hold an election for bonds for building roads. It was thought that sand-clay roads would cost on an average about \$750 a mile in this county.

#### RANDOLPH COUNTY.

Number of miles of public road in county.....	400
Number of miles of unimproved road in county.....	400
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$83,950

Randolph County is located in the midst of the Piedmont section. It organized a County Good Roads Association in 1910, and this association, together with the local press of the county, has kept up a continual campaign for better roads. They have held various meetings for the discussion of some way of securing better roads for the county, and a bond issue for \$300,000 is being advocated. Just when the election will be held to decide this is not known. The movement for better roads has been encouraged by the *Asheboro Courier* in every way possible, which has offered prizes for the best essay on good roads to the public school children; and by many citizens of the county, who have given work and, in many cases, money to assist in improving the roads in their neighborhoods. There are few counties which would



improve more by a good system of public roads than Randolph. It is an agricultural county, and is rather thickly populated. The question of transportation is the biggest one in the county to-day.

#### RICHMOND COUNTY.

Number of miles of public road in county.....	450
Number of miles of improved road in county.....	225
Number of miles of unimproved road in county.....	225
Character of unimproved roads—Earth, with ruts, mud, and some sand.	
Annual loss to county because of unimproved roads.....	\$47,250

Richmond County is located on the southern border of the State, along the western edge of the Coastal Plain region. It is well supplied with road-building materials, both as to sand and clay, and should be able to secure a system of good roads at a comparatively small expense. There has been a great deal of interest aroused in the county in good roads. The Legislature of 1909 passed an act allowing the county commissioners to issue road bonds, provided a majority of the qualified voters signed a petition. The road superintendent of the county has a well-organized road force and a number of drags which he uses on the roads. An act was also passed by the Legislature of 1911 to consolidate all the townships of Richmond County into one system, levy a special tax, and reëstablish a chain-gang.

#### ROBESON COUNTY.

Number of miles of public road in county.....	900
Number of miles of improved road in county.....	25
Number of miles of unimproved road in county.....	875
Character of unimproved roads—Earth, with ruts and some sand.	
Annual loss to county because of unimproved roads.....	\$185,000

Robeson County is also situated along the southern border of the State in the Coastal Plain region. It is a county of large territory, is well populated, has rich farm lands, and an extensive mileage of very poor public roads. There has been much interest felt in the county in improving the roads, and the Legislature of 1911 passed a special act for Robeson County. This act provided for the employment of a highway engineer, who was to be recommended by the State Geologist. The provisions of the act are very complicated and are such as to hamper the work of an engineer to such an extent that the best work could not be accomplished under its provisions. The bill is a cross between the township system and the county unit system. It

provides for the county to be laid off into six districts, and that the taxes collected in each district shall be spent upon the roads of that district. The road work was put under the general direction of a board, to be called the Road Commission of Robeson County, composed of six members, one from each road district. A chain-gang was also provided for. Provision was made in the act whereby any of the several road districts may issue bonds by a majority of the qualified voters of the road district.

#### ROCKINGHAM COUNTY.

Number of miles of public road in county.....	600
Number of miles of improved road in county.....	20
Number of miles of unimproved road in county.....	580
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$121,728

Rockingham is located on the northern border of the State in the Piedmont region. It has a number of manufacturing towns within its borders and a rather numerous rural population. The county has good farm lands and poor roads. There has been, however, much interest awakened in the county during 1911 in better roads and it is believed that during 1912 the county will vote a bond issue for the permanent improvement of its roads; in fact, there is a movement on foot to hold a county bond election for \$500,000. If this fails to carry, it is planned to hold elections in Leaksville Township for \$10,000, and in Reidsville and Williamsburg townships for \$100,000 each. The county has a Good Roads Association and the members of this association have been very active in mapping out a plan of campaign in behalf of this bond issue. Some sample stretches of sand-clay road have been built in the county and it is believed that the great majority of the roads in the county can be built of this material, which will not only give the best of satisfaction, but can be built at a comparatively low cost.

#### ROWAN COUNTY.

Number of miles of public road in county.....	400
Number of miles of improved road in county.....	165
Number of miles of unimproved road in county.....	235
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$49,321

Rowan County is located in the midst of the Piedmont section of North Carolina and its interests are chiefly agricultural, mining, and quarrying. It contains the city of Salisbury. It has constructed a number of miles of macadam and some sand-clay roads out of the



money procured by a special tax and by the use of its convicts. The sand-clay roads were not built under the supervision of a road engineer and have not given the satisfaction that they would have given had they been properly constructed, as to drainage, character of surfacing material, depth of surfacing material, etc. The General Assembly of 1911 passed an act for Rowan County providing for the working of the roads of the county and providing a special tax therefor. The citizens of this county are very much in favor of taking the steps necessary to secure the money for building a system of good roads over the entire county. Boone Township petitioned the county commissioners in April, 1911, to call an election to vote on a bond issue for macadamizing their roads. A demonstration was given in this county by the Indian Refining Company of their road binder.

## RUTHERFORD COUNTY.

Number of miles of public road in county.....	600
Number of miles of improved road in county.....	11 $\frac{1}{4}$
Number of miles of unimproved road in county.....	588 $\frac{3}{4}$
Character of unimproved roads—Earth, with ruts, mud, and steep grades.	
Annual loss to county because of unimproved roads.....	\$125,738

Rutherford County is situated in the western portion of the State just to the west of the Blue Ridge, along the South Carolina line, adjoining Cleveland County. The conditions in Rutherford County are very much the same as in Cleveland, but it has not made the progress in road building that Cleveland has. An act was passed by the Legislature of 1911 levying a special tax for bridges and road building and also authorizing the county commissioners to make appropriations for road demonstration work. There was little interest, however, taken in road work in this county during 1911, except by private individuals.

## SAMPSON COUNTY.

Number of miles of public road in county.....	800
Number of miles of improved road in county.....	90
Number of miles of unimproved road in county.....	710
Character of unimproved roads—Earth and sand.	
Annual loss to county because of unimproved roads.....	\$149,100

Sampson County is located in the midst of the Coastal Plain region, and is well supplied with materials suitable for building sand-clay roads. It is a large county, has rich farm lands, and a good deal of interest is felt in the county in improving the public roads. In December of 1911 this county issued \$50,000 in bonds for the improvement of its roads. Convicts are also used on the public roads.

## SCOTLAND COUNTY.

Number of miles of public road in county.....	300
Number of miles of improved road in county.....	150
Number of miles of unimproved road in county.....	150
Character of unimproved roads—Earth and sand.	
Annual loss to county because of unimproved roads.....	\$36,500

Scotland is a small county located on the southern border of the State along the eastern edge of the Coastal Plain region. It is well supplied with material suitable for building sand-clay roads, and has already constructed a number of miles of such roads. Laurel Hill and Spring Hill townships of Scotland County sold bonds for \$30,000 and \$20,000, respectively, in December of 1911, the proceeds of which are to be used in building sand-clay roads during the coming year. Stuartsville and Williamson townships had already issued bonds for \$50,000 and \$30,000, respectively. With the expenditure of the bond money, and the inauguration of a system of maintenance for the roads already constructed, there is no reason why Scotland County should not have at an early date an excellent system of public roads.

## STANLY COUNTY.

Number of miles of public road in county.....	550
Number of miles of unimproved road in county.....	550
Character of unimproved roads—Earth with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$115,431

Situated in the Piedmont section of the State, Stanly, although a comparatively small county, is rich in natural resources. No attempt has been made up to the present to improve the roads of this county, but, during the year 1911 there has been agitation for an election on a \$100,000 bond issue. There has been considerable sentiment raised in the section between Norwood and Rocky River Springs for good roads, and the Central and Tyson Townships Good Roads Association has been organized. Subscriptions have been made by private individuals for a graded road within this section. There is no reason why Stanly County should not secure an excellent system of roads, and it is believed that a bond issue of \$300,000 to \$400,000 would accomplish this.

## STOKES COUNTY.

Number of miles of public road in county.....	400
Number of miles of unimproved road in county.....	400
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$84,000

Lying along the northern border of the State, Stokes is another one of the Piedmont counties. Its soil is well adapted for agricultural



purposes, and the county is fairly well populated. The roads of the county, however, are in a most deplorable condition. No active steps have been taken by the county for the improvement of its roads, but there is a great deal of sentiment being raised in the county in favor of good roads. In order to stimulate an interest in good roads and to secure a well-built road as a sample for the county, a stock company has been organized to build a modern road as a toll road from Walnut Cove to Buck Island Bridge by way of Meadows, Danbury, and Piedmont Springs. There is also a movement on foot to organize a County Good Roads Association for the promulgation of good roads sentiment in the county.

#### SURRY COUNTY.

Number of miles of public road in county.....	350
Number of miles of unimproved road in county.....	350
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$73,500

Surry County is similarly situated to Stokes and the conditions are practically the same. There is located in this county the large granite quarries of the North Carolina Granite Corporation, and there should be no trouble to obtain broken stone for surfacing material to build a macadam road where the sand-clay road is not a feasible proposition. Mount Airy Township of Surry County has voted a special tax for roads, 30 cents on the \$100 worth of property and 90 cents on the poll. A project was on foot also to build a first-class road from Mount Airy to the White Sulphur Springs by private subscription. The county at large is to have a special tax of 15 cents on the \$100 worth of property for good roads construction.

#### SWAIN COUNTY.

Number of miles of public road in county.....	300
Number of miles of unimproved road in county.....	300
Character of unimproved roads—Earth, with ruts, and mud, and steep grades.	
Annual loss to county because of unimproved roads.....	\$63,000

Situated in the extreme western portion of the State, Swain is traversed by the Great Smoky Mountains. The county is well supplied with minerals and timber, and some farming is done. It covers rather an extensive area and is not very thickly populated. The Legislature of 1911 made provision for the levying of a special tax of from 10 to 30 cents on property and the labor tax is four days for the benefit of the public roads.

## TRANSYLVANIA COUNTY.

Number of miles of public road in county.....	200
Number of miles of unimproved road in county.....	200
Character of unimproved roads—Earth, with ruts, mud, stones, and steep grades.	
Annual loss to county because of unimproved roads.....	\$42,000

Transylvania County is located in the mountain section along the southern border of the State. It is very mountainous and not very thickly populated. Very little interest has been manifested in public roads in this county. The Legislature of 1911 passed an act making the road age from 21 to 45 years, and fixing the road duty at five days in each year. The county uses its convicts on the roads, and it was reported in October that the convict force was doing good work in Brevard Township. There is located in this county the famous Sapphire region with Lake Toxaway, and the owners of this property expect to build a sand-clay road around the lake—a distance of 18 to 20 miles. Some individuals are leading a movement to construct a new road along and a bridge across the French Broad River.

## TYRRELL COUNTY.

Number of miles of public road in county.....	200
Number of miles of unimproved road in county.....	200
Character of unimproved roads—Ruts and sand.	
Annual loss to county because of unimproved roads.....	\$58,948

Tyrrell County is situated in the extreme eastern portion of the State, bordering on Albemarle Sound. The country is low and swampy and not very thickly populated. With the drainage of these swamps, the agricultural portions of the county will be greatly extended and the health of the people will be greatly bettered. The Legislature of 1911 passed an act authorizing a tax of 4 cents on property and 8 cents on polls for the construction of roads. At a meeting held in Tyrrell County during August, the Tyrrell County Good Roads Association was organized; but little enthusiasm, however, has resulted in the county for the improvement of the public roads. This is another county in which there remains work to be done along this line.

## UNION COUNTY.

Number of miles of public road in county.....	900
Number of miles of improved road in county.....	4
Number of miles of unimproved road in county.....	896
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$188,048



Union County is in the southern portion of the State along the South Carolina line. It is a splendid county agriculturally, and also well supplied with minerals. The county is rather thickly populated and there is every reason in the world why it should improve its public highways. There has been considerable agitation in the county for good roads, the movement having been headed by the local press and the County Good Roads Association. The Legislature of 1911 passed a special act for the county, providing for a bond election. They have reported that this election will be held early in 1912. This county is well supplied with material suitable for building sand-clay roads, and the county can ill afford to continue paying the enormous tax to bad roads which is now levied by present conditions.

## VANCE COUNTY.

Number of miles of public road in county.....	400
Number of miles of unimproved road in county.....	400
Character of unimproved roads—Earth, with ruts, mud, and some sand.	
Annual loss to county because of unimproved roads.....	\$84,000

Vance County is in the northern portion of the State, along the eastern edge of the Piedmont plateau, bordering on the Coastal Plain region. The county is well supplied with road materials and there is no reason why it should not have a system of good public roads. There has been a great deal of agitation in the county for good roads. During the year a number of public meetings were held, some of which have been addressed by the State Geologist.

## WAKE COUNTY.

Number of miles of public road in county.....	1,000
Number of miles of improved road in county.....	125
Number of miles of unimproved road in county.....	875
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$162,750

Wake County is situated in the Piedmont plateau on the border-line of the Coastal Plain region. It has a very extensive area, contains the city of Raleigh, and has a large rural population. The county has a special tax for public roads and also a dog tax, the proceeds of which is used for roads. The convicts of the county are also worked on the roads. There has been a great deal of agitation in Wake County for a better system of road building and the Wake County Good Roads Association has been very active in this agitation. It is expected that the county will vote on a bond issue of \$300,000 for road work, but the

date of the election has not been set. A number of meetings have been held in the county in the interest of better roads, and a system of maintenance, and these have been addressed by the State Geologist. On May 10, 1911, the Wake County Good Roads Improvement Council was organized, a body corporate authorized by the General Assembly of 1911. Wake County is well supplied with material for constructing sand-clay roads, and there is no reason why the county should not support a bond issue sufficient to build a system of improved roads covering the entire county. The Central Highway traverses this county.

#### WARREN COUNTY.

Number of miles of public road in county.....	400
Number of miles of unimproved road in county.....	400
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$83,950

Warren is located along the northern border of the State on the eastern edge of the Coastal Plain region. It has no large towns, but a fairly thickly settled rural population and is a county of good resources. It contains large deposits of granite, but agriculture is the principal occupation. The county has no good roads and at the present time no prospects of securing them. There has been some agitation for good roads in the county, and meetings held. The Geological Survey supplied the county with a road engineer to locate a stretch of road in Smiths Township. Warren is another county which can ill afford the enormous tax it is annually paying to bad roads. This county could at a very reasonable cost construct a system of good sand-clay roads, which would increase the wealth and efficiency of the county manyfold.

#### WASHINGTON COUNTY.

Number of miles of public road in county.....	250
Number of miles of unimproved road in county.....	250
Character of unimproved roads—Sand.	
Annual loss to county because of unimproved roads.....	\$73,684

Washington is situated in the extreme eastern part of the State, bordering on Albemarle Sound. It contains very rich farm lands and, when the drainage of certain districts which is now under way is completed, the value of a considerable portion of the county will be greatly increased. The lands, however, would be much more valuable if there were well-constructed roads so that the farmers could market their produce at a reasonable cost for transportation. At present the county has no improved roads at all, but it is believed that it could secure a



system of sand-clay roads at a comparatively small cost. The General Assembly of 1911 passed a special act for this county. They have a tax of 20 cents on the \$100 and 60 cents on the poll, which is expended by townships. Any township may raise the rate by a vote to as much as 10 cents and 30 cents, making a total of 30 cents and 90 cents in such township. The county also has a labor tax. This gives considerable money and labor to be spent in the county on the public roads, but there is nothing done of a permanent nature to show for the expenditure. In August of 1911 there was a meeting held in Washington County, which was addressed by the State Geologist, at which the Washington County Good Roads Association was organized.

## WATAUGA COUNTY.

Number of miles of public road in county.....	300
Number of miles of unimproved road in county.....	300
Character of unimproved roads—Earth, with ruts, mud, and steep grades.	
Annual loss to county because of unimproved roads.....	\$63,000

Watauga County is located in the extreme northwestern portion of the State in the heart of the Blue Ridge Mountains. To date nothing has been done in this county in the way of permanently improving the roads. There has been considerable talk in favor of good roads, but it has not materialized. The Geological Survey has supplied them with a road engineer to help locate a short stretch of road, but so far nothing has been done toward road construction. The county contains magnificent scenery and has many resorts. It has good agricultural land, timber, and minerals.

## WAYNE COUNTY.

Number of miles of public road in county.....	1,000
Number of miles of improved road in county.....	100
Number of miles of unimproved road in county.....	900
Character of unimproved roads—Earth, with ruts, mud, and sand.	
Annual loss to county because of unimproved roads.....	\$189,000

Wayne County lies along the western border of the Coastal Plain region and contains the city of Goldsboro. It is a splendid county agriculturally and the only thing lacking to its rapid progress is a system of good public roads. It is traversed by the Central Highway, and in connection with the work on this highway considerable interest has been aroused in the county in favor of improved roads. A County Good Roads Association has been organized and during the summer of

1911 some sand-clay work was done in the county under the direction of an engineer from the U. S. Office of Public Roads. An act was passed by the Legislature of 1911 providing for an election on a bond issue of \$200,000 for the county, but this has not yet been carried out. This county can well afford a bond issue sufficient to construct a system of first-class sand-clay roads over the entire county, with possibly no increase in the present rate of tax.

## WILKES COUNTY.

Number of miles of public road in county.....	800
Number of miles of unimproved road in county.....	800
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$167,900

Wilkes is a county of considerable area bordering along the eastern slopes of the Blue Ridge Mountains. It is thickly populated, contains the towns of Wilkesboro and North Wilkesboro, and has numerous small manufacturing towns. It is well watered, has a good soil, and the one thing lacking to insure its prosperity is a system of well-constructed roads. There has been a great deal of agitation in Wilkes County all during the year for better roads, this being pushed by the local press and by the Wilkes County Good Roads Association, and also the North Wilkesboro Board of Trade. Many individuals in the county have tried to encourage the building of good roads by making subscriptions for building stretches of sample road, and numerous meetings have been held in the county during the year in the interest of better roads. A great many of the people have contributed labor and teams in an endeavor to put the roads in their sections in better shape. The General Assembly of 1911 passed an act for road work in Wilkes County. The act is long and tedious, with many provisions, but lacking the most important feature of providing means of financing the road proposition. It is Hamlet with Hamlet left out. No county can secure a system of well-constructed roads without going at it in a businesslike way and having them constructed by an experienced road engineer. Money spent by inexperienced road supervisors is money thrown away.

## WILSON COUNTY.

Number of miles of public road in county.....	700
Number of miles of improved road in county.....	31
Number of miles of unimproved road in county.....	669
Character of unimproved roads—Earth, with ruts, mud, and some sand.	
Annual loss to county because of unimproved roads.....	\$140,490



Wilson County is situated in the eastern section of the State in the Coastal Plain region and is a rich agricultural county. In 1905 Wilson Township of Wilson County voted a bond issue of \$100,000, which was expended in the township in the construction of macadam roads. The county at large, however, has not a system of good roads, and it is being felt by progressive citizens in various portions of the county that the whole county is at a disadvantage because of the lack of improved roads. The county could very easily obtain a system of good sand-clay roads at a comparatively small cost.

The Legislature of 1911 passed a special act to establish a road district in Toisnot Township in Wilson County. The citizens in the vicinity have built a sample mile of sand-clay road near the Bloomery Swamp Bridge on the Raleigh road. This was done under the supervision of a Government road engineer.

## YADKIN COUNTY.

Number of miles of public road in county.....	300
Number of miles of unimproved road in county.....	300
Character of unimproved roads—Earth, with ruts and mud.	
Annual loss to county because of unimproved roads.....	\$62,969

Yadkin County is in the Piedmont section of the State and is a small, agricultural county, well populated, and with every reason in the world for a good system of improved roads. To date, however, nothing has been done to insure this. The General Assembly of 1911 passed a special act for Buck Shoals Township, providing a special tax for road building. There is a County Good Roads Association in this county, which, however, has not been very active so far.

## YANCEY COUNTY.

Number of miles of public road in county.....	200
Number of miles of unimproved road in county.....	200
Character of unimproved roads—Earth, with ruts, mud, and steep grades.	
Annual loss to county because of unimproved roads.....	\$43,000

Yancey is one of the westernmost counties of the State, crossed by the Blue Ridge and Bald mountains. The county is well supplied with minerals and timber, and has some farming. Nothing has been done in the way of road improvement in this county, and there seems little prospect of an awakening along this line. The county has no town of any size and a rather sparsely settled rural population.

**SUMMARY OF WHAT THE PRESENT SYSTEM OF WORKING THE  
PUBLIC ROADS IS COSTING THE STATE.**

In order to get at approximately what the present system of road work is costing the State, there is given in the table below figures showing approximately the amount of tax money which was spent on the public roads in the various counties during 1911; the revenue raised by bonds; the equivalent of the labor tax in money, this being estimated at the rate of \$1 per day for the number of day's work during the year in the county; the equivalent of what the convict labor costs the county rated at 50 cents per diem per convict; and the number of miles of improved road obtained through this expenditure.



TABLE VI—WHAT OUR PRESENT SYSTEM OF ROAD WORK IS COSTING THE STATE.

County.	Amount Expended During 1911 from Special Tax.	Amount Expended During 1911 from Bonds.	Cost to County of Free Labor.	Cost to County of Convict Labor.	Total Direct Expenditures.	Number of Miles of Improved Roads Built During 1911 from This Expenditure.	Loss to Citizens Because of Unimproved Roads.	Total Annual Cost to County of Present System.
Alamance.....	\$ 20,000	\$ .....	\$ 9,000	\$ 4,500	\$ 33,500	8½	\$ 79,773	\$ 113,273
Alexander.....	5,000	.....	6,000	.....	11,000	.....	109,500	120,500
Allegheny.....	.....	.....	3,000	.....	3,000	.....	56,940	59,940
Anson.....	14,000	.....	.....	.....	14,000	40	109,511	123,511
Ashe.....	3,000	.....	12,000	4,950	19,950	.....	109,500	129,450
Avery.....	.....	.....	.....	.....	.....	.....	219,000	219,000
Beaufort.....	15,000	.....	6,000	4,500	25,500	2	121,727	147,227
Bertie.....	10,143	20,000	13,200	.....	43,343	51	159,603	202,946
Bladen.....	1,000	.....	9,000	.....	10,000	2	58,210	68,210
Brunswick.....	1,300	15,000	12,000	.....	28,300	8	113,040	141,340
Buncombe.....	56,968	.....	19,600	9,000	85,568	16	117,246	202,814
Burke.....	7,500	.....	6,000	.....	13,500	2½	105,533	119,033
Cabarrus.....	24,000	.....	.....	4,500	28,500	8	60,234	88,734
Caldwell.....	.....	.....	15,000	.....	15,000	5	123,852	138,852
Camden.....	.....	.....	1,000	.....	1,000	.....	44,211	45,211
Carteret.....	1,000	.....	15,000	.....	16,000	5	42,737	58,737
Caswell.....	6,500	.....	7,200	.....	13,700	.....	104,518	118,218
Catawba.....	18,000	.....	17,000	.....	35,000	.....	94,444	129,444
Chatham.....	6,635	.....	12,000	.....	18,635	.....	125,925	144,560
Cherokee.....	3,750	50,000	12,000	.....	65,750	7	81,480	147,230





Guilford.....	24,000	-----	8,400	9,750	42,150	23	130,542	172,692
Halifax.....	25,000	-----	16,000	4,500	47,500	18	150,480	197,980
Harnett.....	3,700	-----	3,000	3,250	9,950	5	162,750	172,700
Haywood.....	4,000	-----	7,200	4,200	15,400	2	36,750	52,150
Henderson.....	10,204	-----	13,016	4,500	27,934	3	164,272	192,206
Hertford.....	4,200	-----	5,000	-----	9,200	-----	176,842	186,042
Hoke.....	5,000	-----	-----	-----	5,000	-----	42,000	47,000
Hyde.....	2,000	-----	2,000	-----	4,000	-----	52,500	56,500
Iredell.....	31,400	-----	16,000	3,000	52,400	6	71,148	123,548
Jackson.....	7,000	-----	5,000	-----	12,000	-----	84,000	96,000
Johnston.....	4,000	-----	16,000	3,250	25,250	25	155,550	180,800
Jones.....	4,440	-----	-----	-----	4,440	2	83,160	87,600
Lee.....	-----	-----	-----	-----	-----	-----	64,790	64,790
Lenoir.....	13,702	-----	-----	3,250	16,952	8	122,850	139,802
Lincoln.....	8,500	-----	-----	-----	8,500	*1 $\frac{1}{2}$	83,885	92,385
McDowell.....	10,000	-----	6,000	2,400	18,400	-----	92,107	110,597
Macon.....	7,500	-----	6,800	-----	14,300	-----	157,500	171,800
Madison.....	4,000	-----	8,000	-----	12,000	-----	63,000	75,000
Martin.....	2,000	-----	10,000	-----	35,000	7	87,780	122,780
Mecklenburg.....	63,695	-----	15,000	17,250	92,945	88	118,580	211,525
Mitchell.....	12,000	-----	8,000	-----	20,000	-----	105,000	125,000
Montgomery.....	5,400	-----	6,000	-----	11,400	10	58,765	70,165
Moore.....	14,000	-----	2,400	-----	26,400	75	117,895	144,295
Nash.....	30,000	-----	-----	6,750	36,750	20	177,500	214,250
New Hanover.....	2,000	-----	1,400	13,500	66,900	17	17,390	84,290

\*Built by private subscription.

TABLE VI—Continued.

County.	Amount Expended During 1911 from Special Tax.	Amount Expended During 1911 from Bonds.	Cost to County of Free Labor.	Cost to County of Convict Labor.	Total Direct Expenditures.	Number of Miles of Improved Roads Built During 1911 from This Expenditure.	Loss to Citizens Because of Unimproved Roads.	Total Annual Cost to County of Present System.
Northampton.....	\$ 14,000	\$	\$ 7,023	\$	\$ 21,023	—	\$ 141,750	\$ 162,773
Onslow.....			8,000	—	8,000	—	73,500	81,500
Orange.....	13,000		4,000	—	17,000	2	57,926	74,926
Pamlico.....	4,000		2,800	4,500	11,300	—	58,948	70,248
Pasquotank.....	12,000			5,250	17,250	—	66,316	83,566
Pender.....			10,000	—	18,000	—	147,369	165,369
Perquimans.....	3,950		10,000	—	13,950	—	95,790	109,740
Person.....	4,800			1,200	6,000	—	125,925	131,925
Pitt.....	10,180			4,650	14,830	3	183,750	198,580
Polk.....	4,500	12,000	4,000	—	20,500	—	62,370	82,870
Randolph.....	6,000		10,000	—	18,000	—	83,950	101,950
Richmond.....	18,500		1,000	—	19,500	55	47,250	66,750
Robeson.....	24,586			3,250	27,836	20	185,000	212,836
Rockingham.....	22,156			6,000	28,156	8	121,728	149,884
Rowan.....	12,000		1,950	9,000	22,950	85	49,321	72,271
Rutherford.....	2,500		10,000	—	14,500	1½	125,738	140,238
Sampson.....	7,000	5,000	15,000	3,300	30,300	21	149,100	179,400
Scotland.....	11,137	50,000		—	61,137	40	36,500	97,637
Stanly.....	4,367		8,000	—	12,367	—	115,431	127,798
Stokes.....			10,000	—	10,000	—	84,000	94,000



Surry.....	4,000	10,000	22,000	73,500	95,500
Swain.....	5,088	6,000	11,088	63,000	74,088
Transylvania.....	3,200	3,000	7,250	42,000	49,250
Tyrrell.....	2,400	1,050	2,400	58,948	61,348
Union.....	15,060	20,000	43,560	188,048	231,608
Vance.....	8,000	7,500	8,000	84,000	92,000
Wake.....	75,000	20,000	105,900	162,750	268,650
Warren.....	12,000	900	12,900	83,950	96,850
Washington.....		9,000	9,000	73,684	82,684
Watauga.....		10,000	10,000	63,000	73,000
Wayne.....	10,000	5,250	15,250	189,000	204,250
Wilkes.....	6,000	12,000	24,000	167,900	191,900
Wilson.....	30,200	4,500	34,700	140,490	175,190
Yadkin.....		12,000	14,000	62,969	76,969
Yancey.....	2,800	12,000	14,800	43,000	57,800
Totals.....	\$ 1,134,354	\$ 40,289	\$ 2,383,157	\$ 10,085,086	\$ 12,468,243

It will be seen from this table that there was spent during the year \$1,466,354 in actual cash, and \$916,803 in labor, either free or convict, making a total of \$2,383,157 as having been directly spent either in maintenance or road construction during the year 1911. For this direct expenditure only 1,583½ miles of public road were especially benefited. Of this mileage, 491 miles was simply graded and not surfaced, leaving only 1,092½ of surfaced road for this expenditure. Only a very small proportion of the above expenditure can be accredited to the surfacing of these roads, as there were only 187 miles of macadam, which averaged about \$3,650 per mile, making \$679,550 spent for macadam roads. There were 549 miles of sand-clay road at an average cost of \$746 per mile, making \$409,554 for sand-clay. There were 297 miles of gravel road constructed at an average cost of \$691, making \$201,087 for the gravel. This makes a total of \$1,290,191 which was expended in specially surfacing 1,033 miles of road. This leaves \$1,092,966 which was spent in road maintenance and in grading 491 miles of road. The maintenance proposition amounted to practically nothing so far as the improvement of the roads was concerned, so that at least \$900,000 of actual outlay has been wasted during the year in the State under the present system of construction and maintenance. In the previous pages under the counties there has been estimated about what it is costing each county to travel over its present system of bad roads. This amount signifies what it would cost the team over and above the cost of traveling over a well-surfaced road, so that the figures represent the actual tax of the bad roads. From this table, it will be seen that the citizens of North Carolina in the various counties are practically paying a tax of \$10,085,086 to bad roads each year. This, together with what we are expending on our roads, shows that the present system of road construction and what we might call nonmaintenance is costing the counties of the State annually \$12,468,243. Is it any the less the loss of the State that this terrible drain is coming out of the individual counties? The State is made up of counties, and any State appropriation which would relieve this enormous outlay would be warranted not only because it would stop the useless waste, but because it would yield a return to the State in increased real estate values, increased population, increased prosperity and happiness of its citizens.

Following this is given some legislation, which, it is believed by the State Geological Survey, will help to do away with the present inefficient and slipshod method of road construction and maintenance in North Carolina.



## PROPOSED LEGISLATION.

For the past several years there has been a growing sentiment in the State that there should be some form of State aid rendered the counties in connection with road construction. This idea was first substantiated when the General Assembly of 1909 passed an act carrying with it an appropriation of \$5,000, to be used by the North Carolina Geological Board "to advise with township and county authorities in building and improving all the public roads, by sending to the township or county a competent road engineer who will assist them in locating their improved roads, advise them as to the best road to build and how to build it, and also give advice regarding the best kind of bridge to be built in connection with the improvement of any road, and that the Geological Board, through the State Geologist, may make inquiries in regard to systems of road building and management throughout the United States and make investigations and experiments in regard to the best methods of road making and the best kinds of road material, and shall disseminate such knowledge by lectures to be given in the different counties and by preparing, publishing, and distributing bulletins and reports on the subject of road improvement, and shall also gather and tabulate information and statistics on road building in North Carolina and disseminate the same throughout the State."

Although the amount appropriated at this time was rather meager when we realize the number of requests for such assistance which are constantly being received by the State Geologist, yet it was a step in the right direction, for the engineers who have been sent out by the Geological Survey to assist counties and townships in their road work have been the means of saving to these counties and townships thousands of dollars which would otherwise have been undoubtedly wasted. While some counties have provided competent road engineers to supervise the location, construction, and maintenance of their public roads, the majority pay little or no attention to such necessity; consequently, there is wasted each year in the State considerable money and a great deal of free labor, which has been taken up in detail under "Progress by Counties." The need of engineering assistance has been very forcibly demonstrated in North Carolina, and all the conventions which have been held throughout the State during the past two years, not only road conventions, but conventions of other wide-awake citizens, have passed resolutions regarding this phase of public road work.

The Geological Survey and the North Carolina Good Roads Association have made suggestions to past Legislatures in regard to the passage of certain legislation with a sufficient appropriation to enable the

State to be of assistance to its counties along this line, and it is hoped that the next Legislature will be able to realize the great importance of this measure.

The following legislation is suggested which will enable the Highway Division of the North Carolina Geological and Economic Survey to give to counties of North Carolina adequate road engineering assistance:

SUGGESTED LEGISLATION FOR ROAD ENGINEERING ASSISTANCE TO  
COUNTIES.

*The General Assembly of North Carolina do enact:*

SECTION 1. In order to further the work of the Highway Division of the North Carolina Geological and Economic Survey in rendering road engineering assistance to the counties in the construction and maintenance of their public roads, there is hereby appropriated, out of any moneys in the Treasury not otherwise appropriated, the sum of \$50,000 annually for the purpose of carrying out the provisions of this act, the same to be drawn upon as directed by the Geological Board.

SEC. 2. Any county desiring engineering assistance from the North Carolina Geological and Economic Survey shall make application for such assistance on blanks specially prepared by the State Geologist, and any county through its county or road commissioners accepting such engineering assistance shall agree to carry out the instructions of the Highway Engineer of the North Carolina Geological and Economic Survey; and shall further agree to construct and maintain the roads according to instructions to be given by the said engineer. Engineering assistance shall also be furnished to the counties relating to the best kind of bridge to be built in connection with the improvement of any road, and any county or township that is contemplating the construction of a bridge to cost over \$500 shall not let the contract for said bridge until the plans and specifications for said bridge have been approved by the North Carolina Geological and Economic Survey, and the final payment, equal at least to 20 per cent of the contract price, shall not be paid by the county or township officials until the construction of said bridge has been approved by the engineer of the North Carolina Geological and Economic Survey. The engineer of the North Carolina Geological and Economic Survey shall also furnish to the county or township commissioners having in charge the road work an estimate of what the proposed bridge should cost, and no bid shall be accepted by said commissioner in excess of the estimate made by the said engineer, except as herein provided. If no bid is received by said commissioners at or under the estimate made by the said engineer, the letting of the contract shall be readvertised, and if no bids are then received at or under the estimate of the said engineer the said commissioners can, with the approval of said engineer, accept a bid in excess of the estimate.

SEC. 3. This act shall be in force from and after its ratification.



**STATE CONVICTS IN PUBLIC ROAD CONSTRUCTION.**

The question of working State convicts on the public roads is one that is being agitated throughout nearly all the Southern States, as well as many Northern and Western States; and where it has been tried it has been decided in nearly all cases that it was in the end the best thing that could be done with the convicts. In North Carolina this question is being given serious consideration, although conditions are different in this State, inasmuch as a large number of the convicts are sentenced directly to the public roads in the different counties, and there is therefore a much smaller number of State convicts than in many of the adjoining States. Thus in North Carolina we have only approximately eight hundred State convicts, of which a certain number at the present time are needed for the care of the prison and for running the State farms. The balance of the convicts, however, that are able, should be used in public road construction; and the sentiment in the end will probably be to work all State convicts on the public roads. Resolutions regarding this have also been passed by a great many of the organizations that have held conventions in North Carolina during the past two years. The following legislation is suggested for working State convicts on the public roads of North Carolina, and it interferes in no way with the present county road forces:

SUGGESTED LEGISLATION FOR WORKING STATE CONVICTS ON THE  
PUBLIC ROADS.

*The General Assembly of North Carolina do enact:*

SECTION 1. That all convicts sentenced to State Prison who are not required in carrying on the work of the State Prison and of the State farms shall be used in working the public roads as hereinafter provided.

SEC. 2. The superintendent of the State Prison shall allot the State convicts to work on the public roads as directed by the chairman of the State Highway Commission, if such office shall be created by the General Assembly, or, otherwise, by the State Geologist. When counties shall apply for State convicts to assist in the construction and maintenance of their public roads, preference shall be given to those counties which do not have a sufficient number of convicts of their own to warrant their maintaining a chain-gang for public road work. When thus allotted to the counties for such work, the county receiving such convicts for road work shall pay the cost of guarding, feeding, and clothing the convicts, and this shall be done in a manner satisfactory to the superintendent of the State Prison. Where it is considered advisable by the Highway Commission, if such commission has been established by the General Assembly, or the Geological Board, the State convicts may be used in the construction of intercounty roads, and the cost of guarding, feeding, and clothing the convicts shall be paid by the superintendent of the State Prison.

SEC. 3. This act shall in no way interfere with the present acts relating to the sentencing of prisoners to work on the roads, and which are now under the control of county authorities.

SEC. 4. This act shall be in force from and after its ratification.

#### STATE SECURITY FOR COUNTY ROAD BONDS.

Another way in which the State can very materially and advantageously assist the counties in the construction of their public roads is for the State to lend its financial support to the counties in obtaining money for the construction of public roads. The State, as we all know, can very readily borrow money at 4 per cent interest, while the county has to pay on an average at least 5 per cent on all the money that it borrows. It requires approximately 1 per cent per year on a forty-year loan to provide a sinking fund which, when put out at compound interest, will equal the principal of the loan. Thus any county issuing \$100,000 worth of bonds would have to provide, besides the yearly interest, a sum equal to \$1,037.60 per year, which, put out at 4 per cent interest compounded, would in forty years provide the principal of \$100,000, or \$933 per year if put out at 5 per cent compound interest. The county, therefore, has to provide 6 per cent each year to take care of its bond issue. Now, the difference at what the State can borrow money, 4 per cent, and the county, 5 per cent—*i. e.*, 1 per cent—will take care of the principal of any loan when it becomes due. If the State, then, would borrow money at 4 per cent and loan it to the counties at 5 per cent, the 1 per cent additional interest which the county would pay to the State would take care of the principal of the bonds issued by the State; and the counties after paying the 5 per cent interest semiannually for forty years would have provided the State with an amount sufficient to pay for the principal. This would mean that all the counties would have to look after would be the 5 per cent interest, and they would not be worried or bothered with the principal, as this would be taken care of by the State. By such a method the State would not have to advance any money on the principal or for interest, and would simply be taking advantage of its credit in borrowing money at 4 per cent and giving the counties the benefit of this. Those counties which have issued bonds and are paying interest and providing a sinking fund know that it takes approximately 1 per cent in addition to the interest to provide for the sinking fund. This question and method have been thoroughly discussed in a paper read by Mr. P. D. Gold, Jr., at the annual convention of the North Carolina Good Roads Association held at Winston-Salem in June, 1911. This is given below:



The question, "*Resolved*, That good roads are profitable," has ceased to be a subject of debate. No theory of Pinchot or Roosevelt for conservation of energy so well conserves as that of the construction of good highways. The nature of the construction and the best road to build is an engineering problem; but, whether constructed of macadam, sand-clay, or other material, the main question, after all, is the necessary funds. The financial end is an important feature, for without the means the end cannot be obtained. If it is possible to pay cash, it is always preferable, but this seldom can be done; therefore, extensive highway construction must be brought about by obtaining money on time, or by the issuing of bonds, as in this way alone can future beneficiaries assist in paying the cost. The civic unit borrowing these funds should be either the township or the county, and of these two the county is preferable.

From the standpoint of the borrower, the paramount question is to obtain the greatest amount of money at the smallest cost; and from the standpoint of the lender, who is the bond buyer, the question is, first, to obtain the best security for his money, and, second, a reasonable rate of interest thereon. As the value of the security decreases, the rate increases. The United States Government, by attaching the circulation privilege, can borrow money at 2 per cent; without this, at 3 per cent; the State can float its bonds at 4 per cent, as they are nontaxable; while the county usually pays 5 per cent on its bonds, as they are not free from taxation; and most individuals pay 6 per cent and upward, according to their standing in the community.

If the county can borrow money at the same rate as the State, saving the difference of 1 per cent per year, this difference would, within a definite period, entirely pay the principal. In other words, in forty-one years the difference in interest between a 5 per cent and a 4 per cent bond, if invested and compounded semiannually at 5 per cent, would mature the bonds at the end of forty-one years. But a county cannot float its bonds at 4 per cent, or even  $4\frac{1}{2}$ ; 5 per cent being the usual rate, and some have to pay even more than this. Furthermore, experience has proven that very few counties will properly care for and reinvest a sinking fund in order to mature its bonds. It is usually the case that the money set aside for a sinking fund is used for other purposes, and at the maturity of the bonds it is necessary to refund. Therefore, if some plan can be devised whereby the county can receive the advantage of the 4 per cent rate and have the difference of 1 per cent properly cared for each year, it would seem worthy of investigation.

The object of this paper is to set forth as fully as the time will allow the details of a method of financing along this line, calling attention to the advantages, while carefully considering and endeavoring to locate and discuss all possible objections. The method suggested is as follows:

The county that cannot obtain a rate of interest lower than 5 per cent, and has need of the proper means of handling a sinking fund, is to vote for an issue of bonds not exceeding a certain percentage of the taxable value of the property of the county. This bond should be an agreement to pay to the State Treasurer a fixed sum semiannually, which should be 5 per cent of the amount of the obligation, such payments to continue for forty-one years, and to be collected and accounted for like other State taxes. This bond is to be submitted to the Attorney-General, so that both form and legality of the vote can

be approved by him. The bond being deposited with the State Treasurer, he would issue in lieu thereof an equal amount of State bonds bearing 4 per cent interest, to be sold at not less than par, the sum thus received to be turned over to the county for the purpose of road building. This fund, of course, should be expended under the supervision of the State Engineer and the county authorities, and used only for permanent road construction. Any amount of bonds could be thus issued up to some fixed amount which would not make the annual bonded indebtedness of the State for a term of years too heavy. Any county desiring this accommodation and properly conforming to these rules could apply, and the amount of bonds issued in any six months should be distributed pro rata in proportion to the amount necessary for them to spend during the first six months. Whether each six months the amount of bonds issued would be fifty thousand, one hundred thousand, or half million, the results would be the same under this plan.

For the sake of argument, we will presume that the amount of the bond issue allowed by the State would be \$100,000. The State Treasurer, therefore, upon the counties depositing \$100,000 of 5 per cent bonds with him, would issue an equal amount of 4 per cent bonds\*. At the end of six months he would issue the same amount of State bonds, less the amount of surplus received, being the difference between the 4 per cent rate paid on the State bonds and 5 per cent received on the county bonds. Every six months, in the same way, the State Treasurer will continue to issue the amount of bonds equal to the amount deposited with him by the counties, less the amount of surplus fund in his hands. Both the county and State bonds would run forty-one years. At the end of the first six months the amount of bonds issued by the State Treasurer would be \$99,500, which together with the surplus fund of \$500, would equal the \$100,000 of county bonds deposited. The surplus fund thus obtained is the difference between  $2\frac{1}{2}$  per cent paid by the county and the 2 per cent semiannual interest paid on the State bonds. At the end of the first year the amount to be issued by the State Treasurer would be \$98,990, which, together with the surplus fund of \$1,010, would equal \$100,000; and each six months thereafter this method would be continued. At the end of the tenth year, provided the counties used \$100,000 each six months, the State would have a surplus, or difference in interest, of \$12,148.80, and be entitled to issue bonds amounting to \$87,851.20. Of course, the State would not issue the odd dollars and cents, but would issue its bonds in even hundred dollars, adding sufficient to make \$100 when the amount was over \$50, and subtracting when under \$50. In one year there might be an excess, but this would be offset in succeeding years by the decrease, and they would ultimately balance. Each succeeding six months the amount of State bonds issued would decrease, and the amount of surplus would increase until, at the beginning of the last semiannual period, or the middle of the forty-first year, the amount of surplus, or difference in interest, would be \$99,324.63, the bonds issued only \$675.37. At the end of the forty-first year, six months prior to the maturing period of the first State bonds issued, the surplus fund would be \$101,811.13, more than sufficient to meet the requirements of the county desiring the \$100,000.

On the date of the first maturing period the State would have in its treasury \$8,200,000 5 per cent county bonds, and have outstanding its own 4 per



cent bonds amounting to \$5,200,000. It would have expended on the roads of the Commonwealth the sum of \$8,200,000, and the increase in the taxable value occasioned by this expenditure during forty years can be at once appreciated. The forty-second year would commence the maturing period, and every six months thereafter \$100,000 of the county bonds would mature and be returned for cancellation. The State's income for the first six months would be  $2\frac{1}{2}$  per cent on \$8,200,000 5 per cent bonds, which would equal \$205,000, \$100,000 of which would be used in retiring the first maturing State bonds, paying interest on the remainder, leaving \$1,811.13 excess, and in the same manner every six months the sum received for interest from the remaining maturing county bonds in the treasury would be sufficient to mature the State bonds issued forty-one years before and maturing that year, paying the interest on those still outstanding, and leave an excess of \$1,811.13 each year.

While it would be eighty-two years from the beginning of the first bond issue before the last bond matured, it would be only forty-one years from the time that particular county first issued its bonds, because the bond maturing the eighty-second year would be the one issued the forty-first year.

The figures have been prepared for each successive year, showing each item of bonds issued, interest received, interest paid, and surplus after the first forty-one years, and after that time the income, bonds retired, and excess. They have been calculated, checked and rechecked by Mr. W. S. Wilson, of the Department of Secretary of State, and are vouched for by him as being absolutely correct. I have only taken the figures at stated intervals to show an outline of the method.

It is impossible for the county to default in interest, because the State has the privilege of collecting just the same as taxes. If at any time no county should desire further bonds, or if for any reason the State should be unable to float its bonds at par, the general plan would not be affected in the least, so long as the surplus fund was reinvested at 5 per cent and compounded semi-annually. The plan, therefore, could not be affected in this way.

To prove the fact that this money can be reinvested at 5 per cent, the State Board of Education has handled the school building fund in this manner several years, and has always had demands for investments at this rate of interest.

If a greater amount than \$100,000 semiannually is desired, these figures would only be multiplied by the figures desired, or, if less than \$100,000, divided in the proper proportion.

The advantages of this method are:

First. That it saves to the individual county the amount of money which it would set aside each year as a sinking fund, *i. e.*, the county issuing \$100,000 of bonds at 5 per cent would have to pay \$5,000 each year for forty years, or \$200,000, and at the end of that time would still owe the principal. In order to lay aside a sinking fund to retire these bonds, it would take 1 per cent, or a total of \$6,000 for forty-one years, which would equal \$246,000. Under the plan above laid out \$205,000 would be all the county would pay, or a saving of \$1,000. In other words, it would cost the county 6 per cent a year to mature its bonds, and this calculation is on the basis that the county would have the most perfect system of caring for its sinking fund. This has seldom proved to be the case.

If bonds which are yearly being refunded were paid, it would be better for both the borrower and the lender. The reason they are not paid is because the sinking fund is not properly cared for. The State could easily, and at small cost, handle this highway bond fund, and, if the same care is taken as is observed by life insurance companies in calculating the reserve for maturing of endowments, the plan would become very simple.

Second. Another advantage is the saving to the county by part of the interest maturing the principal.

I am aware of the fact that there would be criticisms against this plan, but it would seem that if a son desired to borrow money for purposes not only legitimate, but laudable, with his collateral in hand and was able to borrow at 5 per cent, but, with the indorsement of his father, would be enabled to borrow at 4 per cent, saving 1 per cent, which would enable him to pay his indebtedness in a certain period, should not the parent, as a good business man, use his own credit for his son's benefit? The comparison is respectfully submitted as entirely proper, only that in the case of the State it receives a large benefit by the increased taxable value of the property. As to the question between father and son, I would readily answer that it is right, provided the parent's credit is not injured by using it for his son's benefit, and that it does not hinder him from meeting his necessary obligations. There is no question as to the collateral which the State holds. There is no question as to the saving to the county. Would the issuing of these bonds affect the credit of the State? The reply to this would be that it would not affect the State's credit any more than the issuing of any other bonds. In fact, it would have the tendency to add to the credit of the State, rather than injure it, for the reason that there would be a certainty of redemption. Furthermore, there is a guaranteed means of paying both, interest as well as principal. By the enactment of a strict law requiring that the surplus fund should at all times be reinvested in county bonds or returned to the counties under this method, and that the interest on the county bonds should only be used for this purpose and for the redemption of State bonds, the certainty of their redemption and the payment of the interest would make this class of road bonds more desirable than other State bonds. It would be possible to set forth in the State bond the fact that it carried the additional security, and this would tend towards a better price being realized on this bond than other bonds, and in that way improve the salability of whatever other of the State's securities it was desired to float.

If there is any criticism of this plan, it is certainly not against the principle, but against the issuing of any bonds on the part of the State, and, if such a principle is improper, then it would naturally follow that a county's credit would be injured by the issuing of bonds, and this would prevent all bonds issued for road construction, which even the worst enemies of good roads would not contend. So if it is proper for a county to issue bonds for good roads, where is the impropriety in allowing the State to assist it by its indorsement?

The objection might be raised that the outstanding bonded indebtedness would run too large. However, an examination to this effect will show that by issuing \$100,000 every six months, or \$200,000 per year for forty-one years, there is only a bonded indebtedness outstanding of a little over \$5,200,000,



while \$8,200,000 has been expended for the improvement of the county roads, materially increasing the taxable value of the property therein. If the amount of bonds issued annually under this plan was \$400,000, the total bonded indebtedness at the end of forty-one years (which is the period of the largest bonded indebtedness) would be only \$10,400,000, while \$14,400,000 has been expended in the construction of good roads. While this may seem a large amount of money, if we consider the increased taxable value of property during the past forty years, with the increased facilities afforded by road building, and what the increased taxable value would be in the next forty years, we can readily see the increase in tax values would gradually offset the expenditure of the counties on account of these bonds.

It, therefore, would seem that the State and county could both afford it, as the State is guaranteed its income to pay the indebtedness, and the county is benefited because this plan enables it to get its money at a reasonable rate of interest with which it could mature its bond interest without the payment of the principal.

The objection may be raised that this system is a form of paternalism; that the State is fathering the county, and indorsing it to enable the securing of funds. Probably these critics have forgotten the history of the construction of railroads. The State gladly exchanged its bonds for the bonds of railroads which were often owned by private corporations, without even providing the means of redemption. Some of the most valuable property owned by the State of North Carolina to-day is the stock of the North Carolina Railroad, which was obtained in this way. If it is proper to assist a private corporation by exchanging bonds for preferred stock or bonds, then it is certainly legitimate for the State to assist its counties in building highways for the public good.

A further criticism may be advanced that at some future time the counties may be able to secure money at a cheaper rate than 5 per cent. This is answered upon the grounds that all bonds are purchased upon the basis of the present bond market and the present rate of interest, and a man who will not borrow money to-day at 6 per cent to carry on legitimate business because he thinks he may be able to get it for 5 per cent next year will likely die of old age before he accomplishes results. But, provided the county should later be able to obtain cheaper money, it has already obtained the advantage of the improved roads, which will give it an advantage over those counties which have retarded their progress by waiting to get money at a lower rate. However, if the rate should be lowered, it would in no way affect the plan, because those counties which had already gone into it would continue to make payments and mature their bonds.

One of the arguments suggested against this system is the fact that only a few counties would be helped by this act; that the annual bond issue of \$200,000, or even \$400,000, would be such a small amount that only a few counties would derive benefit therefrom. In reply to this, it is to be remembered that during the year 1910, in the State of North Carolina, the entire bond issue for road building aggregated about \$360,000. It is well known that in road construction the entire amount voted is not used at once, but over a period of years; therefore, only about one-fourth would be used in any one year, which, in the year above referred to would only have amounted to \$90,000. Calcula-

lating that the amount voted that year was less than the average, then for the State to furnish \$400,000 it would take probably a \$1,000,000 bond vote from the separate counties. If this would not be sufficient to meet all demands, the amount could be divided pro rata among those counties which had met the requirements, and the further needs of the counties could be secured through some other arrangement.

I have consulted some of the best engineers and financiers in the State regarding this system, and have found all of the engineers consulted enthusiastic on the subject. Among the financiers I have found some who have approached it cautiously, their conservatism being based on their objection to the State issuing large amounts of bonds; but, when they looked carefully into the method, they were forced to confess its features are attractive.

A bill providing for the issuance of bonds under this method was introduced in the last Legislature of North Carolina, was indorsed by the State Highway Association, was opposed by a special joint committee on roads and highways of both Houses, was reported favorably by the full committee on highways and turnpikes, was approved by the committee on appropriations in the Senate, approved by the House finance committee, passed third reading in the House by a vote of 87 to 13, and was only prevented from becoming a law by three majority against it in the Senate. This would seem to be sufficient evidence that there is great merit in the proposition, and that it is one which will be of great benefit to the State, not only for the present, but future generations.

The following suggested legislation is recommended, which embodies this idea:

SUGGESTED LEGISLATION FOR PROVIDING FUNDS FOR THE CONSTRUCTION  
OF PUBLIC HIGHWAYS.

*The General Assembly of North Carolina do enact:*

SECTION 1. That for the purpose of assisting the several counties composing the State of North Carolina in their construction of public roads, the State Treasurer is hereby authorized and directed to issue bonds of the State of North Carolina, payable forty years after date of issue of said bonds, which shall be the first day of July of each year beginning with the first day of July, 1913, to an amount not to exceed \$500,000 annually, and all said bonds shall bear interest at a rate not exceeding 4 per cent per annum from the first day of July of the year they are issued until paid, which interest shall be payable semiannually on the first days of January and July of each and every year so long as any portion of said bonds shall remain due and unpaid.

SEC. 2. That the proceeds received by the State Treasurer from the sale of the bonds authorized in this act shall be loaned to the several counties of the State of North Carolina, as hereinafter provided, to be used by said counties in the construction of macadam, sand-clay, or other surfaced roads as approved by the Highway Engineer of the Highway Division, if such is established by the General Assembly, or by the Highway Engineer of the North Carolina Geological and Economic Survey.

SEC. 3. That the proceeds from sale of the bonds authorized in this act shall be allotted to the several counties composing the State of North Carolina in



proportion to the amount of taxes that the said counties pay into the State Treasury, and any amounts allotted to counties that are not applied for by the counties for which allotted within six months after their allotment shall be reallocated, and loaned amongst the other counties.

SEC. 4. The counties accepting the said loans from the State Treasurer shall pay to the State Treasurer each year 5 per cent of the amount loaned by said Treasurer to said county, which amount shall be payable semiannually on the first days of January and July of each and every year for a period of forty years from the date of the loan. Of the said 5 per cent paid by the county to the State Treasurer, 4 per cent is to be used by the State Treasurer to pay the State's interest on the bonds issued to cover said loans, and 1 per cent is to be retained by the State Treasurer as a sinking fund with which to redeem the bonds issued at the end of forty years when said bonds mature.

SEC. 5. There shall be levied in each and every county accepting a loan or loans, as provided for in this act, a special annual tax for a period of forty years to be known as the "Road Loan Tax," which shall be sufficient to pay and shall be used in paying the annual interest on the loan, said interest to be paid by the treasurer of the county to the Treasurer of the State of North Carolina semiannually on the first days of January and July of each year. As collateral for said loan made by the State of North Carolina to the county, the county commissioners shall issue county bonds to the amount of said loan, and deposit same with the State Treasurer, to be returned to the county at the end of forty years.

SEC. 6. No county shall be allowed to borrow money under the provisions of this act to an amount exceeding 5 per cent of the assessed valuation of the property of the county.

SEC. 7. Any county accepting a loan under the provisions of this act from the State of North Carolina shall expend this money in the construction of macadam, sand-clay, or other surfaced roads, which shall be located, constructed, and maintained under the supervision of the Highway Engineer of the Highway Department, if such is established by the General Assembly, or the Highway Engineer of the North Carolina Geological and Economic Survey.

SEC. 8. That the bonds authorized and directed to be issued by section 1 of this act shall be coupon bonds and of the denominations of five hundred dollars (\$500) and one thousand dollars (\$1,000) each, as may be determined by the said State Treasurer, and shall be signed by the Governor and the State Treasurer, and sealed with the great seal of the State. The coupons thereon may be signed by the State Treasurer alone, or may have a facsimile of his signature printed, engraved, or lithographed thereon; and the said bonds shall in all other respects be in such form as the said State Treasurer may direct, and the coupons thereon shall, after maturity, be received in payment of all taxes, debts, dues, licenses, funds, and demands due the State of North Carolina of any kind whatsoever, which shall be expressed on the face of said bonds. Before selling the bonds authorized to be issued, the Treasurer shall advertise the sale and invite sealed bids in such manner as in his judgment may seem to be most effectual to secure the best price. He is authorized to accept bids for the entire issue or any portion thereof, and where the advantages are equal he shall give the preference of purchase to the citizens of North Carolina; and he is authorized to sell the bonds herein authorized in such manner as in his judgment will produce the best price.

SEC. 9. The said bonds and coupons shall be exempt from all State, county, or municipal taxation or assessment, direct or indirect, general or special, where imposed for purposes of general revenue or otherwise, and the interest thereon shall not be subject to taxation as for income, nor shall said bonds and coupons be subject to taxation when constituting a part of the surplus of any bank, trust company, or other corporation.

SEC. 10. If the bonds issued under this act are sold as bearing less than 4 per cent interest the State Treasurer is hereby authorized to loan said amounts of bonds to the counties at an increase of 1 per cent over the per cent that the State has to pay.

SEC. 11. It shall be lawful for all executors, administrators, guardians, and fiduciaries generally to invest in said bonds.

SEC. 12. This act shall be in force from and after its ratification.



PUBLICATIONS  
OF THE  
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

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BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*
7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
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19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
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## ECONOMIC PAPERS.

1. The Maple-sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganes, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a List of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestone; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*



14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

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24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

25. Proceedings of Second Annual Convention of the North Carolina Forestry Association, held at Raleigh, North Carolina, February 21, 1912. Forest Fires in North Carolina During 1911. Suggested Forestry Legislation. Compiled by J. S. Holmes, Forester, 1912. 8°, 71 pp. *Postage 5 cents.*

26. Proceedings of Fourth Annual Drainage Convention, held at Elizabeth City, North Carolina, November 15 and 16, 1911, compiled by Joseph Hyde Pratt, State Geologist, 1912. 8°, 45 pp. *Postage 3 cents.*

27. Highway Work in North Carolina containing a Statistical Report of Road Work during 1911, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, 1912. 8°, 145 pp., 11 figs. *Postage 10 cents.*

28. Culverts and Small Bridges for Country Roads in North Carolina, by C. R. Thomas and T. F. Hickerson, 1912. 8°, .. pp., .. figs. *Postage .. cents.*

29. Report of the Fisheries Convention Held at New Bern, N. C., December 13, 1911, compiled by Joseph Hyde Pratt, State Geologist, together with a Compendium of the Stenographic Notes of the Meetings Held on the Two Trips taken by the Legislative Fish Committee Appointed by the General Assembly of 1909, and the Legislation Recommended by this Committee, 1912. 8°, .. pp. *Postage .. cents.*

#### VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

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Pt. I.—The Physiography and Geology of the Coastal Plain of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller, and L. W. Stephenson.

Pt. II.—The Water Resources of the Coastal Plain of North Carolina, by L. W. Stephenson and B. L. Johnson. *In Press.*

#### BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

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Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Contains Agreements for Co-operation in Statistical along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders of Purdue University.



Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract; Buncombe County, Transylvania County State Farm, certain Watersheds, Reforestation of Cut-over and Abandoned Farm Lands, on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

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Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

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ECONOMIC PAPER No. 28

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CULVERTS AND SMALL BRIDGES  
FOR COUNTRY ROADS IN  
NORTH CAROLINA

By

C. R. THOMAS

Highway Engineer United States Office of Public Roads

and

T. F. HICKERSON

Associate Professor of Civil Engineering, University of North Carolina ; and  
Highway Engineer, North Carolina Geological and Economic Survey.



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## LETTER OF TRANSMITTAL

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CHAPEL HILL, N. C., July 1, 1912.

*To His Excellency, HONORABLE W. W. KITCHIN,*  
*Governor of North Carolina.*

SIR:—I beg to submit herewith for publication as Economic Paper No. 28 a report on Culverts and Small Bridges for Country Roads in North Carolina. It is believed that this report will be of great value to the road officials in the various counties of the State and help to counteract the present inadequate methods now in use in this detail of road construction.

Yours respectfully,

JOSEPH HYDE PRATT,  
*State Geologist.*

## PREFACE

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The following paper on Culverts and Small Bridges has been prepared to meet a very great demand which has arisen in the various counties for definite and accurate information regarding this subject. Unfortunately, at the present time, only a few of the counties of the State are employing competent road engineers to have supervision of their road work, and no provision has as yet been made by the State to give to the counties engineering assistance. This paper has, therefore, been prepared in such detail and written in such a way as will make it adapted to the requirements of the supervisors and foremen in charge of county work and it will also be of value to road engineers.

There is a great lack of uniformity in the construction and use of culverts and bridges and many of those in charge of road work do not appreciate the need and the demand for good culverts and bridges as they do not realize the importance of bridges in connection with road work.

This report has been prepared by Mr. C. R. Thomas, Highway Engineer, United States Office of Public Roads, assisted by Professor T. F. Hickerson, Associate Professor of Civil Engineering in the University of North Carolina, and Highway Engineer of the North Carolina Geological and Economic Survey.

The State Survey is indebted to the United States Office of Public Roads for the loan of many photographs used in this report.

JOSEPH HYDE PRATT,  
*State Geologist.*



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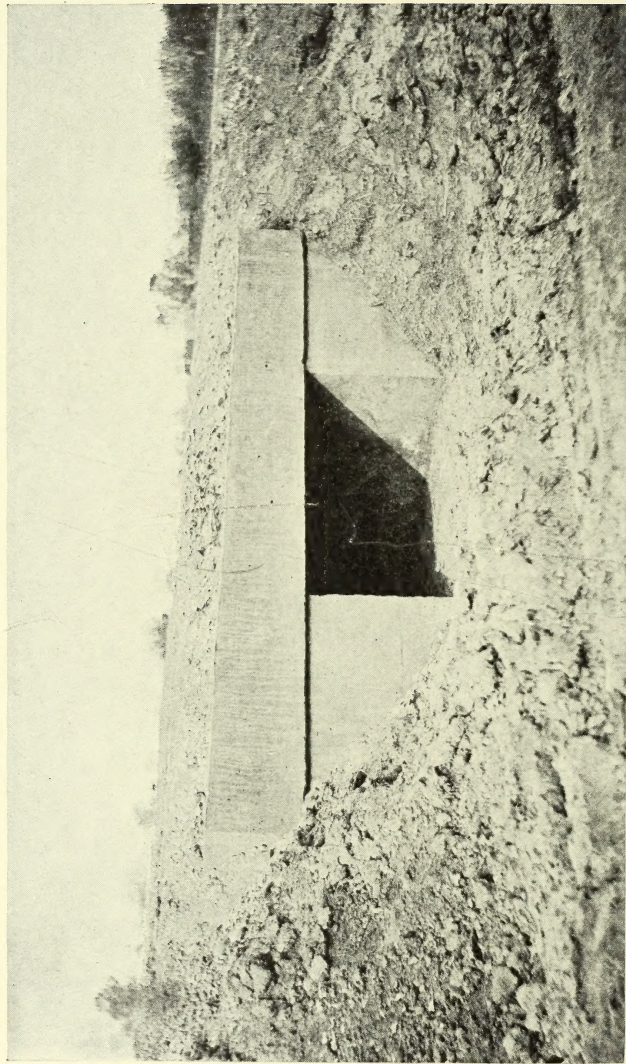
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A Well Proportioned and Well Constructed Concrete Culvert.



# CULVERTS AND SMALL BRIDGES FOR COUNTRY ROADS IN NORTH CAROLINA

By

C. R. THOMAS and T. F. HICKERSON

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## INTRODUCTION

The rapid progress made in the improvement of roads throughout the State in the past few years has led to the demand for a much better class of culverts and bridges than it has been the practice heretofore to build. As a result, there has been a marked general improvement in the character of waterways and an increased interest among county officials in their construction. There still remains, however, a lack of uniformity in construction and a proper appreciation of the many types of culverts which are suitable for small waterways.

It is the aim of this bulletin to cover these points in a manner intelligible to a road builder of some experience. In doing this, matter has been included which is comparatively simple to an engineer. On the other hand, a road superintendent who has had some experience in building culverts and small bridges, and understands a drawing should have no difficulty in using such of the designs and suggested methods of construction as may suit the conditions under which he is working.

Bridges larger than those treated in this bulletin require a separate design for each case and should not be attempted except under the direction of a competent bridge engineer.

## CLASSIFICATION AND TYPES OF WATERWAYS

Culverts are small waterways extending entirely under and across the roadway, and are called "wet" or "dry" depending upon whether they provide a channel for continually flowing streams or occasional surface water due to heavy rains. The distinction between a culvert and bridge is rather vague in some cases, but generally all waterways which do not require some special design and can be constructed according to standard plans, are classed as culverts. A convenient, although arbitrary, distinction for country roads is to class all waterways requiring no guard rails for the protection of travelers as culverts, and all structures requiring such protection as bridges.

Culverts may be either through or crossover; through culverts being used to convey water under the road at a point where it flows beyond

the right-of-way immediately, and crossover culverts conveying the water from one side ditch to the opposite side ditch.

#### MATERIALS AND TYPES OF WATERWAYS.

Formerly wood was the principal material used for both culverts and bridges on country roads in the State. Of late years, however, the price of lumber has increased and the quality diminished to such an extent that only in very few places can it be used economically. As a substitute, or improvement, many other materials have come into general use. Vitrified clay pipe, cast-iron pipe and corrugated metal pipe are used for small drains; brick, stone and concrete are used for variously shaped small openings and larger culverts and bridges.

The increased use of concrete is to be commended. It is a material reasonably cheap in most localities and absolutely permanent when properly placed in structures properly designed. Too much stress can not be laid upon the care necessary in using this material.

Each of these materials has its advantages and disadvantages for use in different sections of the State, and for different locations on the roads, and a blind faith in any one of them is a lack of good judgment.

#### SELECTION OF THE PROPER TYPE OF WATERWAY.

The determination of the kind of waterway to use is a matter of experience and judgment based in general upon the following factors:

(1) Cost.

Dependent on:

(a) Availability of material and labor.

(b) Character of foundations.

(2) Type of road on which it is built.

(3) Size of opening necessary.

(4) Headroom (distance from road surface to water surface) available.

(5) Convenience of construction and character of the soil.

(1) The factors entering into the determination of the amount of money a county or road district is warranted in expending on culverts and small bridges may be briefly summarized:

(a) Safety and convenience demand that their condition be good at all times, since a failure stops travel and may injure the travelers.

(b) A permanent culvert, while more expensive to construct, is less expensive than a number of less permanent culverts, which must be built from time to time.

(c) Repairs are largely eliminated in a permanent culvert. Small repairs in small culverts are exceedingly expensive in proportion to the cost of the material used.



While there may be cases where it may be desirable to use material which is not very durable, it may be stated as a rule, that *the less durable the material used the more expensive in the long run will be the culvert.*

The relative cost of different types of culverts varies greatly in different sections of the State, but the approximate costs in the central portion are given in the last part of this bulletin.

(2) The more permanent the nature of the road the more lasting should be the nature of the culverts and bridges on it. For instance, a small timber structure should never be used on a road on which \$4,000 to \$5,000 per mile has been expended. On the other hand, on a comparatively unimproved road through a timbered country, a wooden structure may be economical.

(3) The size of opening required influences the type which may be used. Vitrified pipe is not ordinarily used for diameters greater than 24 inches. Cast iron and corrugated iron pipe are used for diameters as great as five feet. Other materials may be used for all sizes.

(4) The headroom, or distance from the ordinary water surface to the road surface, may be such as to prevent the use of arch tops or even necessitate the use of very shallow flat top slabs. Vitrified pipe should not be used unless sufficient headroom is available to provide a protecting cover of earth above the pipe.

(5) It frequently happens that material is on hand which can not otherwise be used, or foremen can do better work with certain materials, or the progress of other portions of the road construction work are involved. Under these and other conditions it may be advisable to use a special type of culvert. Again, the soil may wash badly, requiring paved bottoms or specially designed outlets.

The selection of the proper material and type of culvert is a problem worthy of careful consideration by the road official, the correct solution of which will result in a considerable saving of money.

## CONSTRUCTION OF WATERWAYS

### LOCATION.

As a general rule the waterway should be placed at the point where the greatest flow of water will occur during heavy rains. Unless this is done the capacity of the culvert is decreased and the opportunity for washouts increased. It is remarkable how often this simple rule is neglected.

The best outlet for the water should control the location under ordinary conditions. Water that has passed through the culvert and can not get away prevents other water from flowing through and the road is

flooded from both sides. So far as possible, a broad, straight outlet and inlet should be provided. In case this is a ditch it should have flat side slopes, and, if bends are necessary they should be at some distance from the culvert.

Many culverts are destroyed by undermining at the lower end; and in the examination of the site the character of the soil should be noted and, where necessary, provision made to prevent erosion.

Under ordinary circumstances, culverts should always be placed at right angles to the center line of the road. In order to increase the capacity or decrease the tendency to deposit silt at the inlet, the culvert is sometimes run diagonally (on a skew) across the road in the general direction of the stream or drainage ditch. On a steep hillside where a crossover culvert limited in size must be used, or where the course of the stream can not be readily changed, as where rock is encountered, it may be advisable to place it on a skew. Only in very rare cases, however, will the advantage gained offset the added cost of the additional length and more complicated headwalls required.

Where the road is unimproved or has not been graded as thoroughly as will be necessary in succeeding years, probable changes in grade or alignment should be estimated and the culvert located to fit them. This is very important if a permanent culvert is to be used. It is folly to build a concrete culvert so short or in such a position that when the road is improved the culvert must be rebuilt.

Small culverts under long fills to take care of backwater can often be eliminated with economy by providing one opening sufficiently large. This condition is met with frequently in the eastern part of the State.

In the location of small bridges the following factors which ordinarily enter into the selection of the site of larger structures may influence the location to some degree.

A bridge should be located:

- (1) Where best foundations may be secured.
- (2) Where the stream is narrow and banks high, thus reducing the cost of construction.
- (3) Where the stream is straight above and below the bridge.

It is possible, sometimes, to reduce the number of bridges required to accommodate the same travel, as illustrated in Fig. 1, p. 11.



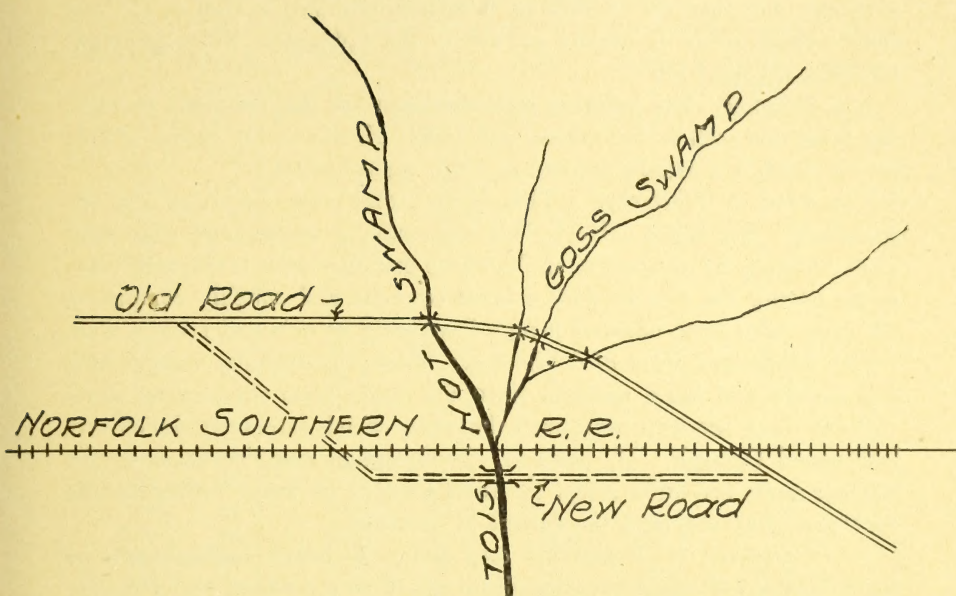


FIG. 1.—Three bridges were eliminated by re-locating this road.

#### SIZE OF OPENING.

A culvert should be large enough to provide for all ordinary rainfall which may come upon the area it drains. It is not advisable on country roads to make the size as great as would be required by the record breaking rains which sometimes occur. The damage occasioned by a washout once in 15 or 20 years is not sufficient to offset the added cost in making the structure large enough to care for the additional water.

No great refinement in the determination of the area of waterway is possible or necessary. The convenience and economy of the use of standard sizes and designs makes the problem one of determining which of several standard sizes will be more nearly satisfactory. For example, should a 24-inch pipe, which has an area of 3.14 square feet, be too small, the next size, a 30-inch pipe, would be used, which has an area of 4.92 square feet, or 56 per cent greater than the 24-inch. The same thing holds true with other types of waterways.

As a general rule it is well to make small culverts larger than the water to be provided for demands. They are subject to stoppage from drift and accumulations of leaves and grass, and to avoid this some road builders make 15 inches a minimum diameter for pipe culverts.

The two problems which generally arise are to find the area of waterway for a new opening or, more frequently, to determine the size to use in replacing an old structure. The same elements are involved in both

problems, but they are of such an indeterminate nature that in the end their consideration is merely an aid to the judgment. The principal elements involved are:

(1) *Rainfall*: The ordinary maximum rainfall may be taken as varying from one inch to two inches per hour. However, the extent of this severe rainfall is usually limited to a few square miles.

(2) *Area of Watershed*: This is the total area draining into the waterway. For small culverts this area may be determined with sufficient accuracy by estimation, if the whole drainage area is in plain view, or by pacing the divides with a hand compass and roughly computing the area. For large culverts it may frequently be obtained from a map.

(3) *Shape and Slope of Watershed*: When the drainage area is long and narrow and has a uniform slope, the water from the remoter parts will not reach the waterway until the water which falls near the culvert has passed through. If, however, the drainage area is round or the remoter parts are quite steep, the total amount of water falling on the watershed may arrive at the culvert at one time.

(4) *Character of Vegetation and Soil*: A heavy undergrowth or forest carpet will check the immediate runoff of the water, and a porous soil will absorb a large portion of an ordinary rain. But should a heavy rainfall come when the soil is thoroughly saturated the total rainfall may reach the culvert.

(5) *Location and Design of Waterway*: The slope of the culvert and condition of the channel above and below the ends will influence the capacity.

The capacity may be increased by permitting the water to dam up at the inlet. This is sometimes permissible with a pipe or a paved bottom culvert, but should be avoided with other types.

There are two general methods of determining the area (1) by formulas, (2) by direct observation.

Formulas should never be used except as a check or guide to the judgment. They should be disregarded altogether in replacing an old culvert or where the areas may be determined by direct observation under conditions similar to those which will exist when the culvert is completed.

(1) *By Formulas*: There are several empirical formulas in general use, of which the one given below is probably best suited to conditions in this State.



TABLE 1—AREA OF WATERWAYS

Drainage Area (Acres)	Very Mountainous (Sq. Ft.)	Mountainous (Sq. Ft.)	Very Hilly (Sq. Ft.)	Hilly (Sq. Ft.)	Rolling (Sq. Ft.)	Gently Rolling (Sq. Ft.)	Prairie (Sq. Ft.)
5	3.3	2.2	1.7	1.1	0.8	0.6	0.5
10	5.6	3.7	2.8	1.9	1.4	1.1	0.9
15	7.6	5.1	3.8	2.5	1.9	1.5	1.3
20	9.5	6.3	4.7	3.2	2.4	1.9	1.6
25	11.2	7.5	5.6	3.7	2.8	2.2	1.9
30	12.8	8.5	6.4	4.3	3.2	2.6	2.1
40	15.9	10.6	8.0	5.3	4.0	3.2	2.6
50	18.8	12.5	9.4	6.3	4.7	3.8	3.1
60	21.6	14.4	10.8	7.2	5.4	4.3	3.6
80	26.8	17.8	13.4	8.9	6.7	5.4	4.5
100	31.6	21.1	15.8	10.5	7.9	6.3	5.3
120	36.3	24.2	18.1	12.1	9.1	7.3	6.0
140	40.7	27.1	20.4	13.6	10.2	8.2	6.8
160	45.0	30.0	22.5	15.0	11.2	9.0	7.5
180	49.1	32.8	24.6	16.4	12.3	9.8	8.2
200	53.2	35.6	26.6	17.7	13.3	10.6	8.9
220	57.1	38.0	28.6	19.0	14.3	11.4	9.5
240	61.0	40.8	30.5	20.3	15.2	12.2	10.2
260	64.8	43.2	32.4	21.6	16.2	13.0	10.8
280	68.5	45.6	34.2	22.8	17.1	13.7	11.4
300	72.1	48.1	36.0	24.0	18.0	14.4	12.0
340	79.2	52.8	39.6	26.4	19.8	15.8	13.2
360	82.6	55.2	41.3	27.6	20.6	16.5	13.6
400	89.4	59.6	44.7	29.8	22.3	17.9	14.9
450	97.7	65.2	48.9	32.6	24.4	19.5	16.3
500	106.0	70.4	52.9	35.2	26.4	21.1	17.6
550	114.0	75.6	56.7	37.8	28.4	22.7	18.9
600	121.0	80.8	60.6	40.4	30.3	24.2	20.2
650	129.0	85.8	64.3	42.9	32.2	25.7	21.4
700	136.0	90.8	68.0	45.4	34.0	27.2	22.7
750	143.0	95.4	71.6	47.7	35.8	28.7	23.9
800	150.0	100.0	75.2	50.1	37.6	30.1	25.1
850	157.0	105.0	78.7	52.5	39.4	31.5	26.2
900	164.0	110.0	82.1	54.8	41.1	32.9	27.4
950	171.0	114.0	85.5	57.0	42.8	34.2	28.5
1000	178.0	118.0	89.0	59.2	44.4	35.6	29.6
1100	196.0	127.0	95.5	63.7	47.8	36.2	31.8
1200	204.0	136.0	102.0	68.0	51.0	40.8	34.0

## TALBOT'S FORMULA.

Opening (sq. ft.) =  $\sqrt[4]{(\text{Drainage area [acres]})^3}$

Very mountainous  $C=1$ . Mountainous  $C=\frac{2}{3}$ . Very hilly  $C=\frac{1}{2}$ . Hilly  $C=\frac{1}{3}$ . Rolling  $C=\frac{1}{4}$ . Gently rolling  $C=\frac{1}{5}$ . Prairie  $C=\frac{1}{6}$ .

(2) *By Direct Observation*: This is the most satisfactory method of

determining the size of opening to use. Highwater marks should be ascertained from people in the locality, and the area of cross-section measured at a point where the stream is narrow and the banks steep. The culvert or bridge opening should have approximately the same area as that measured.

It is often convenient to remember that a rainfall of one inch per hour on one acre equals one cubic foot per second.

Sluggish or tidal streams, such as exist near the coast, may be narrowed considerably. On the other hand, mountain ravines should have a larger opening than the appearance of the banks would seem to warrant.

In crossing a wide flat where the water sometimes overflows the whole surrounding country, culverts or small bridges should be large enough to take the ordinary flow only, permitting extreme floods to continue to overflow.

#### FOUNDATIONS.

The foundation under a culvert or bridge should provide an unyielding support for the structure above. The footing or base of the structure should be so designed that the weight is distributed evenly over the foundation.

The supporting power of various soils differs widely, and if there is any doubt as to its character it is well to dig pits or obtain a core of the soil by driving down a one-inch iron pipe before putting in the footing.

TABLE II—TABLE OF SAFE BEARING CAPACITY OF SOILS IN TONS  
PER SQUARE FOOT AREA OF FOOTING

Material	Tons Per Square Foot
Quick sand and wet soils.....	0.05 to 1.0
Dry loam.....	1.0 to 1.5
Soft clay.....	1.0 to 2.0
Sand, clean, dry.....	2.0 to 4.0
Moderately dry clay.....	2.0 to 4.0
Clay, always dry.....	5.0 to 7.0
Sand, compact and cemented.....	4.0 to 6.0
Gravel cemented.....	8.0 to 10.0
Rock.....	5.0 to 200.0

The area of the base of the wall or footing should be sufficient so that the load will not exceed the values given in the table. The footing may be broadened to secure this or it may rest upon (1) a timber platform or (2) piles. A soft foundation may be improved by compacting or by spreading over it a layer of sand or gravel from 12 to 18 inches thick.



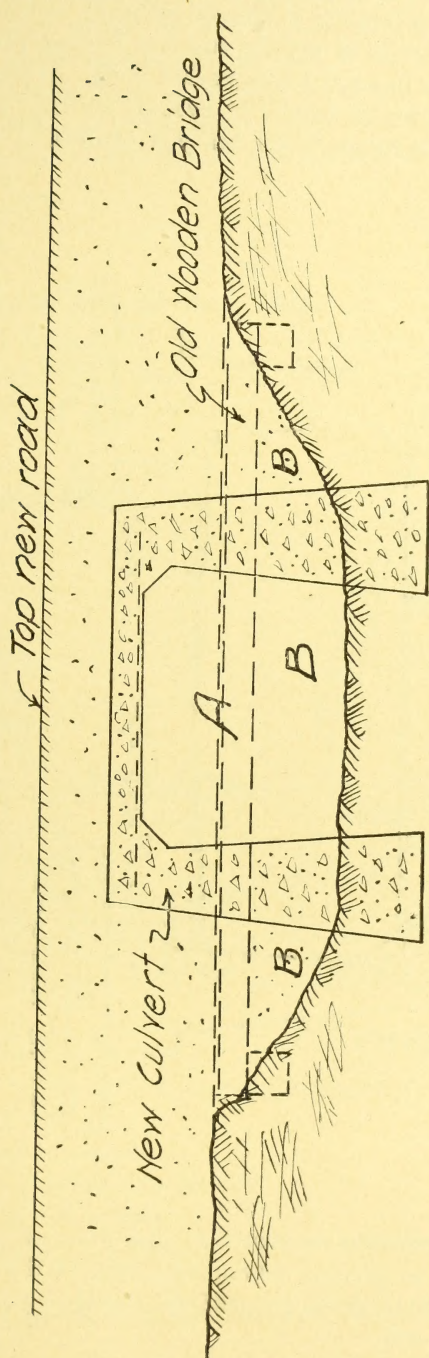


FIG. 2.—In replacing an old culvert the area of waterway of the new culvert should be approximately the same as that under the old culvert. (Area A should equal area B, B, B.)

For small concrete structures resting on ordinary, moderately dry soil, it is generally sufficient to spread the concrete footing, precaution being made to prevent scour in a soil which washes badly. If the foundation is soft, as it often happens in marshy or swampy sections, additional support for the footing is necessary for heavy structures.

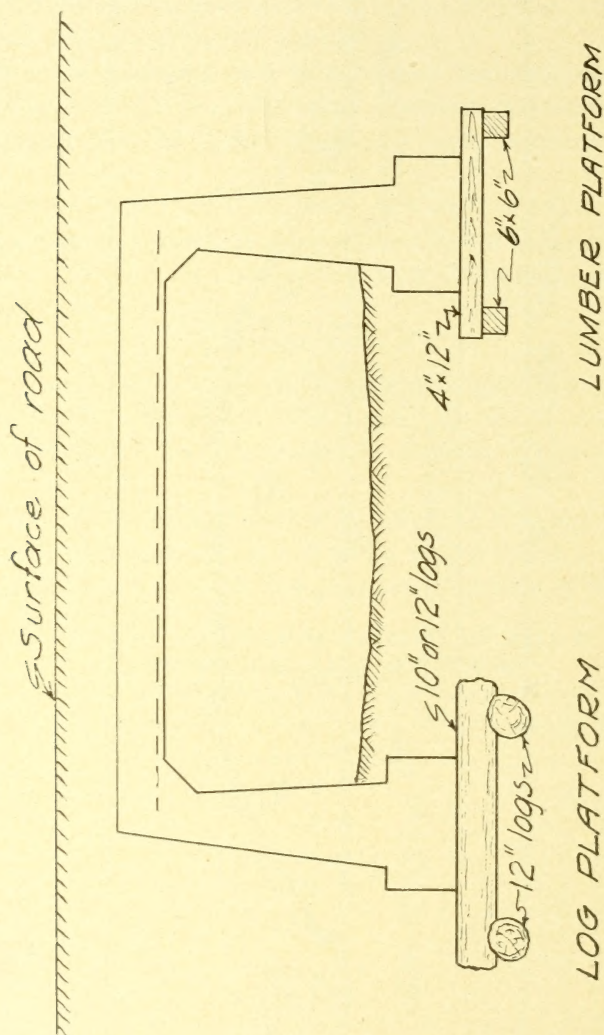


FIG. 3.—Methods of spreading the weight of a concrete structure over a large foundation area.

A log or plank platform as shown in Fig. 3 serves to distribute the pressure and tends to prevent uneven settlement of the footings or tipping of the abutments. A timber platform should only be used where it will be continually wet.



In some cases for more important structures it will be necessary to use piles. These piles should be driven close together ( $2\frac{1}{2}$  to 3 feet for foundations), sawed off below the surface of the water-level and a timber platform built on them, or concrete deposited around the tops. The number to be used may be determined while they are being driven. The *Engineering News* formula for the safe bearing power is given below:

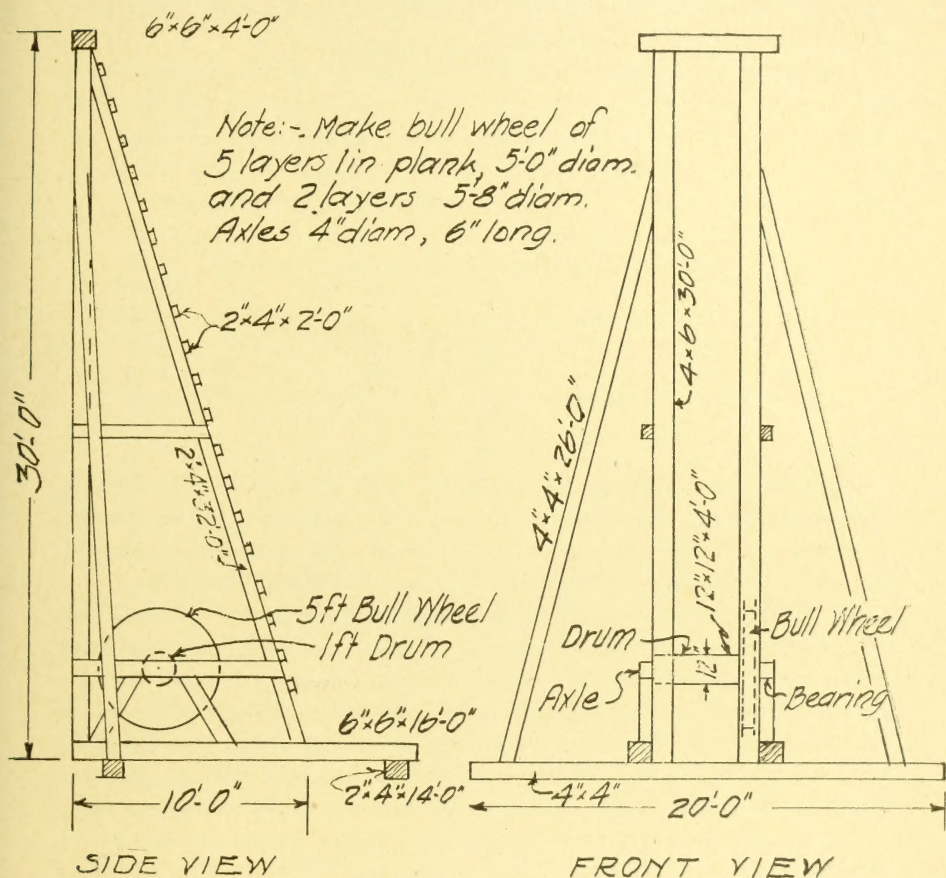


FIG. 4.—A portable pile-driver.

$$P = \frac{2wh}{s+1}$$

P = safe load in pounds.

W = weight of hammer in pounds.

h = height of fall in feet.

s = penetration or sinking in inches under the average of the last three blows.

Piles should be ten to twelve inches in diameter at the butt and not

less than six inches at the point. In driving an iron hoop should be used at the top to prevent splitting and brooming. Ordinary pine piles will cost from 12 cents to 20 cents per lineal foot delivered at the job in most sections of the State. In ordinary soil the cost of driving short foundation piles should not exceed \$1 each.

Pile driving is often a troublesome matter on small isolated jobs, and the portable pile driver illustrated in\* Fig. 4, p. 17, will prove convenient if much work is to be done.

This driver is operated by a rope running through a snatch block at the top and around the drum. Another rope wound around the "bull wheel" is hitched to a horse. The hammer is raised by the horse and tripped from the "nipper" at the top. The weight is about 1 1-4 tons, exclusive of the hammer. The total cost will be approximately:

700 ft. B. M. lumber @ \$25.....	\$ 17.50
Bolts and nails (24½ in. x 8 in. bolts).....	2.00
Labor.....	18.00
1 1200 lb. cast iron hammer.....	50.00
1 pair of nippers.....	5.00
1 snatch block.....	3.00
240 ft. of 1 in. manila rope.....	10.00

---

\$105.50

The foundation must be able to carry the load upon it permanently. The main factors which tend to destroy the permanency of the foundation are: (1) liability of scour in the bottom and consequent undermining of the footings; (2) frost and (3) undermining of the outlet.

(1) Scour in the bottom may be prevented by covering the earth bottom with a stone pavement from 8 to 12 inches in thickness or by using a thin pavement of concrete about 6 inches thick. In small concrete culverts the footing is frequently made solid across the entire bottom of the culvert, as in Plate X, the bottom serving both to distribute the load and prevent scour. In larger structures, a cut-off wall, as shown in Plate XIV, is often used. When no provision is made to prevent scour the side walls should be not less than 18 inches below the bed of the stream.

(2) Frost, while a serious matter farther north, seldom penetrates deeper than 6 inches in this State. Any footing carried below the surface of the ground 12 inches is safe from frost.

(3) Undermining at the outlet is generally caused by water dropping some distance at the end, or the increased velocity of the water due to contraction in passing through the culvert. This may be prevented by paving the outlet with stone or concrete, or by the use of a baffle wall, as illustrated in Plate X. As a last expedient, if considerable wash has

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\* From "Handbook of Cost Data" by H. P. Gillette.



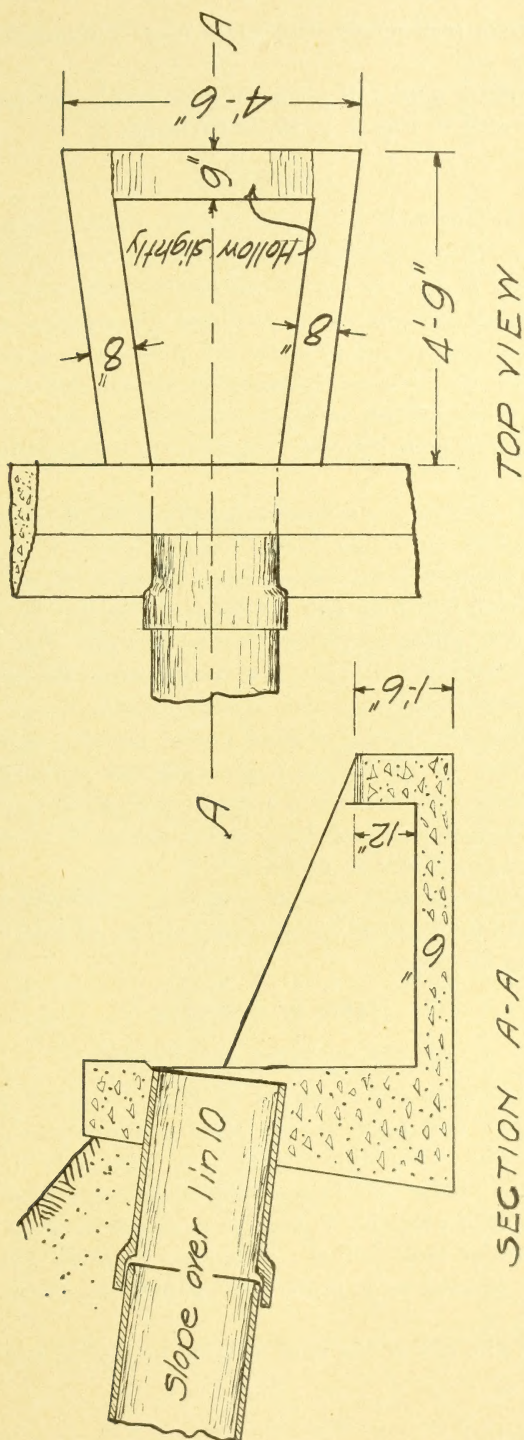


FIG. 5.—Concrete outlet drop for use in soils which are easily eroded.

already occurred, rock mixed with earth may be dumped in to prevent further scour.

Where the water must fall a considerable height the use of an outlet drop as illustrated in Fig. 5, p. 19, is advisable.

#### COFFERDAMS.

When foundations must be prepared under water, a cofferdam is generally necessary to keep out the water while the footing is being placed. When the water is deep or the current swift these cofferdams are very expensive and the construction of each one is a separate problem which should not be attempted except under the direction of a competent engineer. However, in the construction of small culverts and bridges, the water seldom exceeds 6 feet in depth, and where there is a mud bottom, free from boulders, little difficulty should be experienced in constructing cofferdams,

Fig. 6, p. 21, illustrates a cofferdam which, under favorable conditions, will cost about \$200 for a pier 25 feet long. The 6"x 6" uprights should be driven first with the lower waling strips bolted to them. The top waling strips are then bolted on and the sheeting driven. In still water the outer line of sheet piling may sometimes be omitted. The puddle should be made of the best clay obtainable and should extend below the bed of the stream. It is well to have the inner line of sheeting 4 or 5 feet from the masonry to allow for driving another line of sheeting inside the cofferdam if necessary. If the bottom is good and the puddle wall carefully built, a small hand pump, with the aid of a small sink in one corner, will generally keep the bottom dry. If the bottom is sandy or gravelly a gasoline bilge pump will be useful.

If the foundation is solid rock and there is no current in the stream the concrete may be deposited in bags until the water level is reached, no cofferdam being necessary.

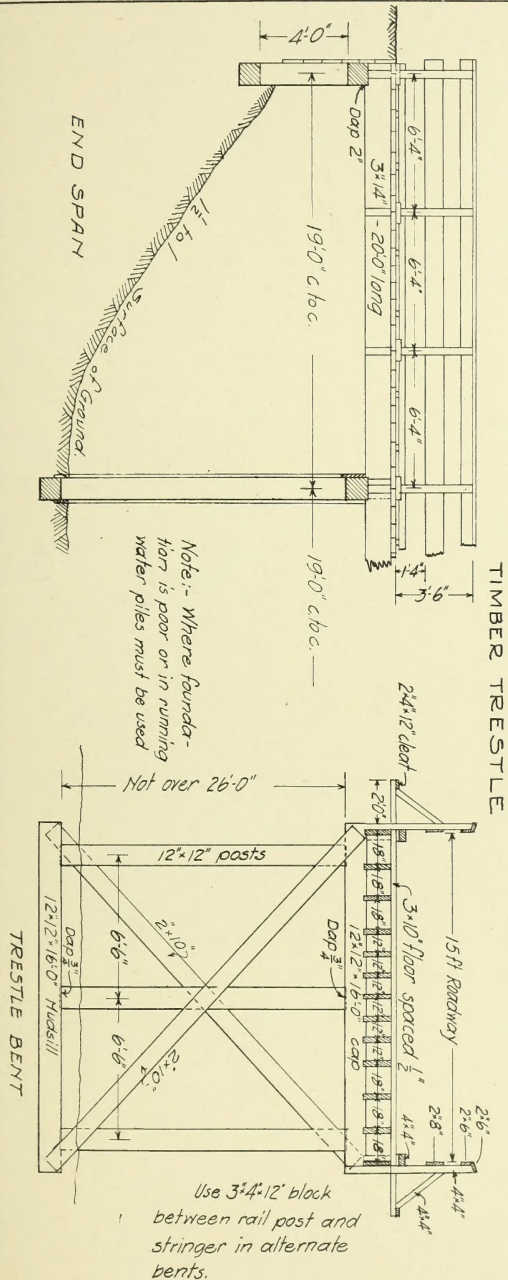
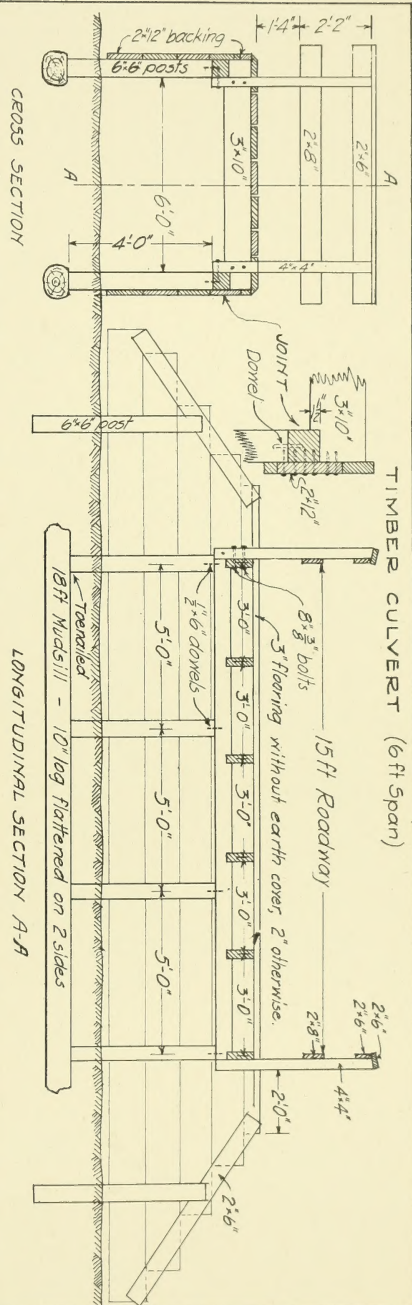
#### TYPES OF CULVERTS

##### TIMBER CULVERTS AND BRIDGES.

In any timber structure it should be borne in mind that wherever wood is in contact with earth (except when continually under water) it will decay rapidly. For this reason it is advisable to use heavier material at these points than is required for strength alone. If timber is the only material available it may be advisable in some cases to use creosoted lumber at these points. In salt or brackish water, creosoted lumber should be used as a protection against the inroads of marine wood-borers.

*Material:* White oak is the most durable lumber to use in road cul-





## Types of Timber Structures.





verts. Red oak should be avoided, especially when in contact with earth. Pitch pine free from large knots is durable and makes satisfactory floor joists. Rough sawed lumber should be used since there is a considerable loss in planing. Three inch oak flooring should be used where the wear

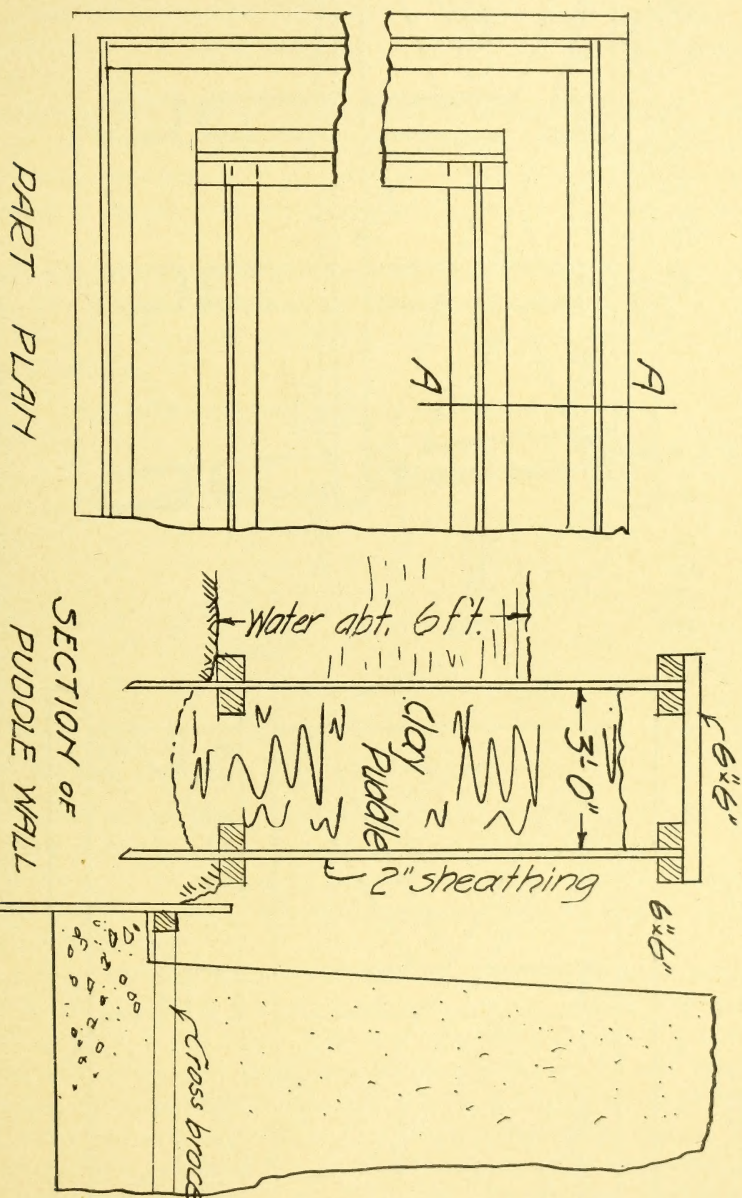


FIG. 6.—Cofferdam for use in shallow water.

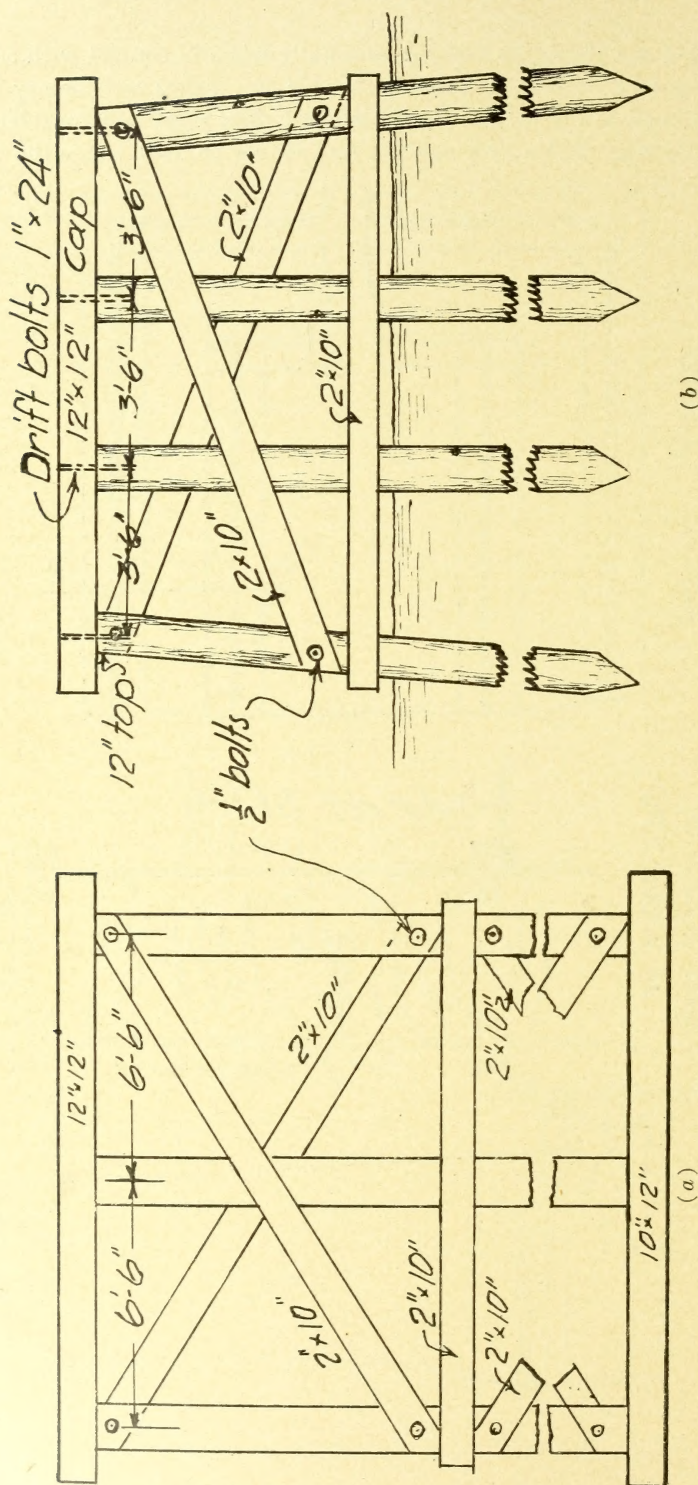


Fig. 7—(a) Dry land trestle bent. (b) Pile trestle bent.



comes directly on the floor. Its durability is twice that of two inch flooring, although it costs only one-third more, since flooring must be renewed when worn to an inch thickness.

Creosoted lumber is much more durable than ordinary timber and will cost about \$45 per 1,000 ft. B. M. in the eastern part of the State.

*Small Structures:* Wood should never be used for any waterway where a pipe can be used.

The ordinary type of small timber culverts as constructed in most sections of the State consists of a mudsill imbedded in an earth bank with floor joists resting directly upon it. Most of the failures come from undermining of the earth abutments or floating off of the entire structure.

A small culvert constructed as shown in Plate I should last until it rots out. The cost of a culvert of this type is approximately \$35.

Table III below shows the size and spacing of wooden floor joists for longer span culverts.

TABLE III—WOODEN BRIDGES (15' ROADWAY)

Span	No. of Joists	Size	Length	Spacing	Total Ft. B. M. in Floor and Joists
8'	6	3"x12"	10'	3' 0"	660
10'	7	3"x12"	12'	2' 8"	828
12'	8	3"x12"	14'	2' 3"	1008
14'	9	3"x12"	16'	2' 0"	1200
16'	6	4"x16"	18'	3' 0"	1440
18'	6	4"x16"	20'	3' 0"	1600
20'	7	4"x16"	22'	2' 8"	1877
24'	9	4"x16"	26'	2' 0"	2500

Use 3" flooring 16' long.

When timber structures are used on a surfaced road the floor may be covered with surfacing where the span does not exceed 16 feet.

*Timber Trestles:* In the eastern portion of the State there are many places where timber trestles are still economical and when well built they are fairly durable.

Plate I shows a design for a trestle which may be used in many localities. The end spans are best constructed as shown, making the end abutment not over 6 feet high. The flooring should be spaced  $\frac{3}{8}$  inch to prevent dirt and refuse from accumulating. The guard rail illustrated is substantial and need not be disturbed in repairing the floor, the flooring planks on each side of the post being lapped to fit around it. Where trestle bents exceed 16 feet in height they should be cross-braced on both sides, as illustrated in Fig. 7a, p. 22. Rough hewn timber is satisfactory for posts.

Pile bents should be used in running water or where the bottom is too soft to use a mudsill. The piles should be from 12 to 18 inches in diameter at the butt and not less than 6 inches at the point and should be driven to a good bearing. The tops should be sawed level and the cap put on and drift bolted as shown in Fig. 7b, p. 22. Not less than 4 piles should be used in a bent and it is well to batten the outside piles if the water is deep or the current swift.

#### PIPE CULVERTS.

Pipe culverts are generally circular in cross-section and vary from 8 inches to 48 inches in diameter. The materials used in them are vitrified clay, corrugated sheet metal, cast iron and concrete. Their circular shape gives great strength in proportion to the amount of material used, a large discharge for the cross-sectional area, and provides a non-eroding surface for the water to flow along. On the other hand they require a greater height (diameter) for a given area of waterway than a square or rectangular box and must be carefully laid on an even slope.

Pipes smaller than 12 inches in diameter should not be used for culverts, owing to the danger of stoppage by trash and mud, and unless a good fall is obtained (say 1 ft. in 20 ft.) they should be not less than 15 inches in diameter. Some road builders even advocate that 18 inches should be the least diameter used unless a catch-basin is provided at the upper end.

Pipe culverts are usually laid in sections or joints varying in length from 2 to 3 feet for vitrified pipe, to 12 feet for cast iron pipe. In order that the whole pipe may act as a solid piece and retain an even slope from end to end:

- (1) The foundation under the pipe must be solid.
- (2) The joints must be tight and strong.

In ordinary clay or loam soil, if care is used in trimming the bottom of the trench in which the pipe is to be laid, so that the earth directly under the pipe is not disturbed, the foundation will be satisfactory. If it is necessary to fill any part of the trench the earth should be thoroughly tamped before laying the pipe.

In swampy, or other uncertain soils, where the weight of the fill, or other loads which may come on the pipe, are apt to cause it to settle in the middle, a pipe having as few joints as possible should be used. The foundation may be improved (1) by excavating the bottom of the trench at least 6 inches below where the bottom of the pipe will be and filling in with sand or cinders, if such material be available, or (2) a support of concrete or stone may be placed under each joint as shown in Fig. 8, p. 25.









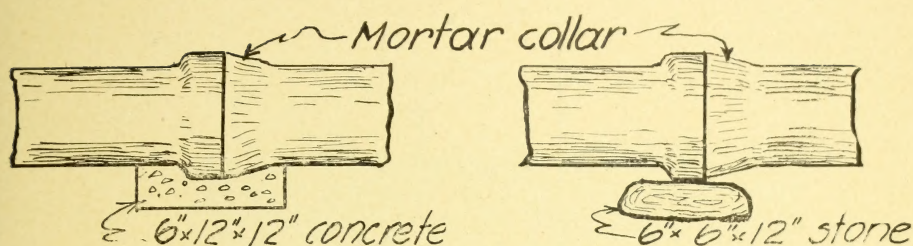


FIG. 8.—A support should be used under the joints of a pipe culvert in soft ground.

Where a support under each joint is necessary the pipe should be made of cast iron or corrugated sheet metal.

In filling in the trench around the pipe the earth should be carefully tamped in thin layers until the pipe is at least half covered. Care should be used to make the trench wide enough to allow tamping under the pipe. This tamping is very important when laying vitrified pipe.

The least fall from end to end of a pipe culvert should not be less than 4 inches. The least fall to allow for ordinary conditions is about 1 foot in 20 feet of length. Too much fall is dangerous since it tends to cause erosion at the outlet. Too little fall reduces the discharge, allows sediment to deposit and permits water to stand, the continual freezing of which sometimes completely closes and in some cases destroys the pipe.

*Headwalls for Pipe Culverts:* As a general rule the ends of pipe culverts should be protected by endwalls. This protection is especially necessary for pipes laid in short sections. For long sections it is not so important, but it will usually be found that the saving in length of pipe will very nearly offset the cost of the headwalls and the culvert is more substantial with headwalls.

The types of headwalls generally used are shown in Fig. 9, p. 26.

The wall type, Fig 9 (c), will generally be found cheapest and most satisfactory when the diameter of the pipe is less than 36 inches. For diameters greater than 36 inches the straight or flared wing type, Fig. 9 (a), (b), contain less material and the parapet wall is much shorter, lessening the liability of wash around the ends. The straight wing type is usually used at the outlet end of the pipe and the flared wing type at the inlet end.

Headwalls may be built of concrete, as shown in Plate II, stone or brick.

#### VITRIFIED PIPE.

The use of vitrified clay sewer pipe for culverts is limited to places where at least 12 inches of earth may be secured above the top of the pipe, where a solid bed may be obtained and (in the western part of the

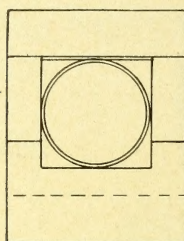
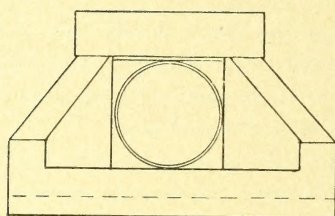
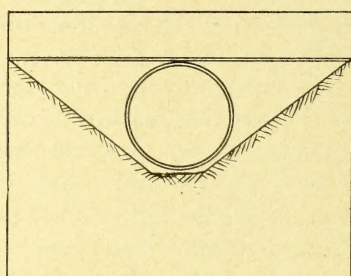
(a) *Straight Wing*(b) *Flared Wing*(c) *Wall End*

FIG. 9.—Types of end walls.

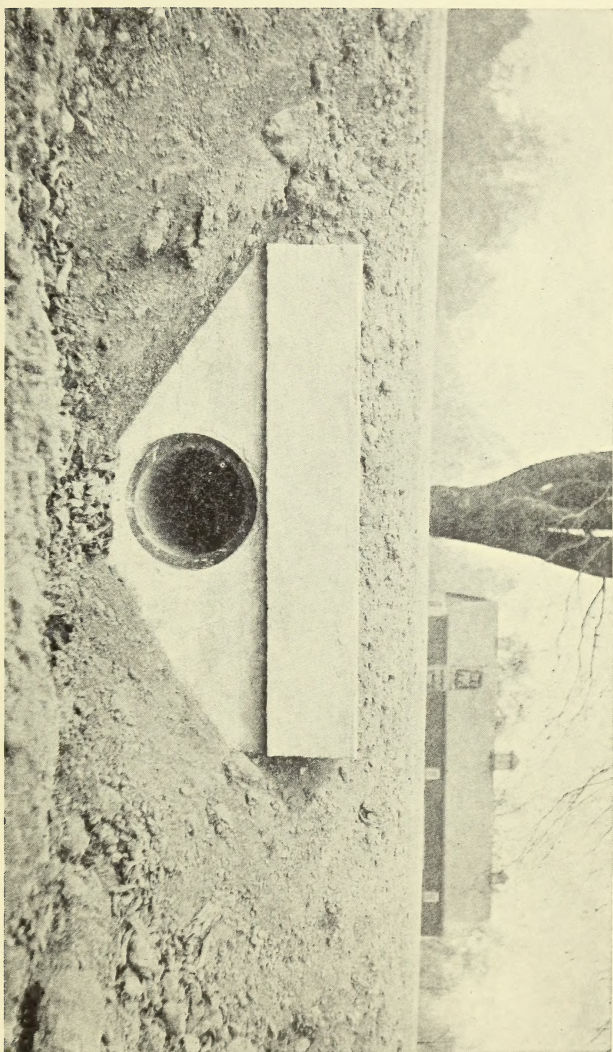
State) the fall is sufficient to prevent the possibility of water standing and freezing in it. Many failures have resulted from attempting to use this type of culvert when these conditions did not exist. If conditions are favorable, however, the culvert will be very durable. Plate II illustrates a good method of laying culverts of this type.

The relative advantages and disadvantages of vitrified pipe for culverts may be briefly summarized.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>(1) Low in first cost.</li> <li>(2) Desirable in that it will not rust or decay.</li> <li>(3) Quickly laid.</li> </ul>	<ul style="list-style-type: none"> <li>(1) Requires heavy earth protection.</li> <li>(2) Has little supporting strength.</li> <li>(3) Requires a headwall under all conditions.</li> <li>(4) Requires care in handling and laying.</li> </ul>

Vitrified sewer pipe is made in joints 2 to 3 feet in length and in two thicknesses of shell known as "single strength" and "double strength" pipe. If conditions are such that vitrified pipe may be used at all,





Concrete End Wall for a Vitrified Pipe Culvert.





"single strength" pipe is usually as satisfactory as "double strength" and is much more economical.

The joints should be filled with a 1:3 cement mortar and tapered off with a cone-shaped collar of mortar, as shown in Fig. 9, to prevent water leaking through the joints, but if there is much danger of the pipe sagging at the center under the weight of this fill a stiff clay may be used in place of the cement mortar.

TABLE IV—SIZES AND COSTS OF VITRIFIED PIPES

Inside Diameter of Pipes in Inches	Area in Sq. Ft.	Single Strength per Foot of Length			Approximate Cost per Lineal Ft. in Place
		Weight in Pounds	List Price*	Price F. O. B. Raleigh, N. C.	
10	0.54	32	\$0.65	\$0.16	\$0.50
12	0.79	43	0.85	0.21	0.60
15	1.23	65	1.25	0.30	0.80
18	1.77	86	1.70	0.41	1.00
20	2.18	100	2.25	0.54	1.15
24	3.14	131	3.25	0.78	1.50
30	4.91	270	....	....	....
33	5.94	320	....	....	....
36	7.07	365	....	....	....

\*Discounts on list prices f. o. b. cars at factory vary from 70% to 75%.

## CAST IRON PIPE.

The chief use of cast iron pipe for culverts is in those places where the earth cover is so small that vitrified pipe would not be safe, where practically no cover may be obtained as in some ditch crossings or road intersections, where there is liability of water freezing in the pipe and where the foundation is too poor to use an easily broken pipe. Corrugated metal pipe serves the same purpose and while much less durable is some cheaper.

Cast iron pipe is made in 3, 6, and 12 foot lengths of round pipe and a number of triangular, half round, and oval patented shapes. The patented shapes have no advantage over the round pipe, except in ease of handling.

This pipe should be carefully laid as described for vitrified pipe.

## CORRUGATED METAL PIPE.

Corrugated metal pipe is made of thin, corrugated sheets of steel or iron bent and riveted in round and half-round sections. The corrugation gives it great strength in proportion to the amount of metal used, its strength, when the metal is the proper gauge, being sufficient to support any load which may ordinarily pass over the road. The metal used is very thin and, should the protecting coat of galvanizing be destroyed, it will rust away rapidly. For this reason it is advisable that the metal

be pure galvanized iron since pure iron rusts much less rapidly than steel. The cost of pure iron is, however, somewhat greater than steel.

This type of culvert has been in use only a few years, not long enough to determine its durability. Manufacturers claim a life of from 15 to 25 years. It is probable, however, that the life is largely dependent upon the type of soil in which it is laid. If laid in a damp soil containing a large amount of organic matter, the action of organic acids will probably cause it to rust out within 10 years. On the other hand, if laid in a dry, loam soil, its life should greatly exceed this.

Corrugated pipe can be used to advantage where the earth cover over the top of the pipe is small. In this case, headwalls are advisable to prevent wagon wheels from crimping the ends. At ditch crossings, road intersections, places where water is liable to freeze in the pipe, and for temporary purposes during the construction of larger waterways this material will be found very convenient and satisfactory. Half-round sections may be used where a hard foundation, such as rock or shale, may be secured.

It is important that the thickness of the metal used and the size and number of rivets should be in proportion to the diameter of the pipe. A convenient method of determining the thickness of the metal is to weigh the pipe and divide the weight by the length, the result giving the weight per foot of pipe, which should correspond to the values in Table V for the thickness given.

TABLE V—SIZES AND COSTS OF CORRUGATED PIPE

Diameter Ins.	Area Sq. Ft.	Gauge Iron	Weight per Foot Lbs.	* Cost per Foot
12	0.79	16	11	\$0.80
15	1.23	16	13	0.95
18	1.77	16	16	1.10
24	3.14	15	24	1.60
30	4.91	15	28	2.30
36	7.07	14	38	2.90
42	9.62	14	44	3.60
48	12.57	12	69	4.60
60	19.64	12	85	6.00
72	28.27	10	130	8.80

\*Cost per foot is f. o. b. any railroad station in the State. 15%-20% discount on carload lots. 10%-15% discount on less than carload lots.

Note.—Weight is approximately 1 pound per foot for each inch in diameter.

#### BRICK MASONRY.

Culverts and end walls may be built of brick. As a rule, however, the cost is greater than concrete, due to the skilled labor required to lay brick properly, and the results are not so substantial.



In some cases, however, where material is scarce, they make very satisfactory end walls for pipe culverts. Hard-burned bricks should be used, laid in 1:3 cement mortar. When laid with  $\frac{1}{4}$  inch joint, about 550 bricks will be required per cubic yard. Brick endwalls should be not less than 16 inches thick.

#### RUBBLE MASONRY.

In the western part of the State it will usually be convenient and economical to build small culverts of roughly dressed stone, either laid in cement mortar or laid "dry" without mortar. As a rule the saving in labor will more than repay the use of mortar and the culvert is much more satisfactory. General specifications for building road culverts of this material are given in the Appendix.

Rubble stone requires careful laying, especially if "dry." Large flat stones should be used in the bottom and each stone carefully embedded as the wall is built up, using as few spalls, or small chinking stones, as possible. Long header stones should be used as ties at least every 2 feet of height.

There is a tendency to use too little mortar in laying rubble. A thick coat of mortar should be spread and the stone firmly embedded in it. Mortar should consist of 1 part Portland cement to 2 or 3 parts clean coarse sand. The method of using a thin mortar grout in building the interior of the wall should not be permitted. For spans up to 4 feet, flat cover stones may be used for the top. These stones should have the thickness shown in Plate XIII and should be of sound material.

Plate XIII gives the dimensions and quantities for culverts of this type. If there is danger of erosion in the bottom of the culvert it should be paved as shown.

Rubble masonry laid in 1:3 cement mortar will cost from \$5.00 to \$6.00 per cubic yard. "Dry" rubble will cost from \$3.50 to \$4.00 per cubic yard. These prices will vary with the character and abundance of rubble stone.

#### CONCRETE.

Concrete is a properly proportioned mixture of cement, sand and stone, which when mixed with water forms an artificial stone. It is called plain or reinforced depending on whether steel is used to give it additional strength.

Concrete culverts and bridges possess the following merits:

- (1) Permanent.
- (2) Can be built with inexperienced labor.
- (3) Require no repairs.
- (4) Materials are readily obtained.

On the other hand they must be properly designed and carefully built to be satisfactory.

The methods and cost of handling concrete is too large a subject to enter into, except in a general way, in a bulletin of this character, even when confined to culverts and small bridges. A number of general methods of construction and tables are given in the text and the reader is referred to the specifications in the Appendix for specific direction.

*Cement:* Portland cement may be bought in wooden barrels containing about 3.8 cubic feet and weighing about 380 pounds, or in cloth bags, four bags making one barrel. It is usually more convenient to obtain the cement in bags which are easy to handle and may be returned to the dealer and redeemed for from five to ten cents apiece. Cement should be stored in a dry place until used. Out on the work, it should be placed on a wooden platform preferably raised six inches above the ground and should be covered with canvas at night.

*Sand:* Cleanness is the main point to consider in selecting sand. Vegetable loam is more dangerous in sand than ordinary clay. A double handful of sand dropped in a bucket of clean water ordinarily should not dirty the water so the sand can not be seen after a couple of minutes. A small amount of clay (not over 5 per cent) is generally not injurious, but the sand should not be used if the clay is of an impervious kind ordinarily called "buckshot" or "crawfish." Sand may be washed by dumping in a running stream and keeping it stirred with hoes.

Coarseness is important next to cleanness. Concrete made from a coarse sand is much stronger. If the sand is composed of coarse, medium and fine grains, with the medium grains predominating, and is clean, it may be called ideal.

*Stone:* Stone should be sound and free from dirt. What is known as "crusher run stone" made up of pieces of all sizes, with the dust and dirt screened out is usually best. The largest size stones to use depends on the thickness of the wall and whether reinforcing steel is used. For foundations and walls thicker than 8 inches stone up to  $2\frac{1}{2}$  inches in longest diameter is satisfactory unless the reinforcing steel is placed so close together that the stones can not get between. For walls less than 8 inches thick and where the steel is closely spaced, stones larger than 1 to  $1\frac{1}{4}$  inches should not be used. Where machine-crushed stone is not obtainable it may be broken with a hammer, a good man being able to break from 3 to 5 cubic yards of  $2\frac{1}{2}$  inch granite per day. Larger stones may be imbedded in thick walls and foundations, provided they do not touch each other and are at least 6 inches from the surface. Screenings from a rock crusher may be used for sand if free from dirt and the rock is hard. Granite screenings are very satisfactory.



*Gravel:* Gravel should contain hard rounded stones. Shale gravel should never be used and gravel containing mica or much soil should be washed before using. Sandy gravel usually contains a greater or less quantity of sand than desired. This may be corrected when mixing by adding a portion of stone or sand.

*Methods of Mixing:* In building culverts and small bridges two mixtures of concrete will generally be sufficient.

For *heavy work*, as in footings, walls, piers and abutments, use 1 part cement,  $2\frac{1}{2}$  parts sand, and 5 parts stone or screened gravel ( $1:2\frac{1}{2}:5$ ).

For *thin reinforced work*, as in culvert tops, beams, thin wing walls and other thin work use a  $1:2:4$  mixture.

The proportion of sand to stone or gravel will vary with the kind of stone used and the degree of screening. A slight change in the amount of sand to secure a dense mixture should be made where necessary. As a rule the concrete should have slightly more mortar than necessary (say 55-60 per cent) since, while the strength is slightly affected, it is much easier to secure a smooth surface finish free from pockets.

In calculating the amount of each material to use the sand is considered as filling the voids (air spaces) between the stones, and the cement as filling the voids between the sand grains, giving only a slightly greater volume of concrete than the original volume of stone. For example, a  $1:2:4$  mixture of concrete would contain 4 cubic feet of stone, 2 cubic feet of sand, and 1 cubic foot of cement, giving about 4.2 cubic feet of concrete.

Table VII gives the amounts of each material to secure one cubic yard of concrete, and the proper amount of each material required for an even number of bags of cement is shown in Table VI.

TABLE VI—VOLUME OF CONCRETE MADE FROM ONE BAG OF PORTLAND CEMENT, BASED ON A BAG OF 0.95 CUBIC FEET

Proportions by Parts			Proportions by Volume			Ratio of Mortar to Stone	Volume of Rammed Concrete in Cubic Feet Made from One Bag of Cement		
							Percentage of Voids in Broken Stone or Cement		
Cement	Sand	Stone	Cement Bags	Sand Cu. Ft.	Stone Cu. Ft.		Per Cent.	50%	45%
						Cu. Ft.		Cu. Ft.	Cu. Ft.
1	2	4	1	1.90	3.80	57	4.07	4.30	4.50
1	2½	4	1	2.38	3.80	62	4.30	4.50	4.70
1	2½	4½	1	2.38	4.28	60	4.67	4.90	5.15
1	2½	5	1	2.38	4.75	54	4.95	5.20	5.45
1	3	5	1	2.85	4.75	61	5.27	5.52	5.80
1	3	6	1	2.85	5.70	52	5.80	6.10	6.40
1	1	0	1	0.95	0	..	1.42	cu. ft.	mortar
1	2	0	1	1.90	0	..	2.13	cu. ft.	mortar
1	3	0	1	2.85	0	..	2.87	cu. ft.	mortar

TABLE VII—QUANTITIES OF MATERIALS FOR ONE CUBIC YARD OF RAMMED CONCRETE\* BASED ON A BARREL OF 3.8 CUBIC FEET

Proportions by Parts			Ratio of Mortar to Stone Pr. Ct.	Percentage of Voids in Broken Stone or Gravel								
Cement	Sand	Stone		‡50 Per Cent			‡45 Per Cent			‡40 Per Cent		
				Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
				Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.
1	2½	4	57	1.65	0.46	0.93	1.57	0.44	0.88	1.50	0.42	0.84
1	2½	4	66	1.52	0.54	0.86	1.46	0.51	0.82	1.40	0.49	0.79
1	2½	4½	60	1.44	0.51	0.91	1.37	0.48	0.87	1.31	0.46	0.83
1	2½	5	54	1.37	0.48	0.96	1.30	0.46	0.92	1.24	0.44	0.87
1	3	5	61	1.28	0.54	0.90	1.22	0.52	0.86	1.17	0.49	0.82
1	3	6	52	1.16	0.49	0.98	1.11	0.47	0.94	1.05	0.44	0.89

NOTE.—Variations in the fineness of the sand and the compacting of the concrete may affect the quantities by 10% in either direction.

\*Quoted from Taylor and Thompson's Reinforced Concrete, John Wiley & Sons, New York.

†Use 50% columns for broken stone screened to uniform size.

‡Use 45% columns for average conditions and for broken stone with dust screened out.

§Use 40% columns for gravel or mixed stone and gravel.

In determining the amount of cement to use with a sandy gravel, the sand and gravel are considered as already mixed. For example in a 1:2:4 mixture 4 cubic feet of mixed sand and gravel would require about 1 cubic foot of cement. Ordinarily, however, sand or stone must be added to the gravel to make the proportions correct. The amount to add is determined by sifting the gravel on a 1-4 inch mesh screen and measuring the amounts passing through and retained on the screen. Sandy gravel is often found containing coarse sand but very little fine sand. A small amount of fine sand added will increase the strength and give the mortar a desirable smoothness.

The ingredients of concrete are carefully measured before mixing. Cement comes in measured packages. Sand, stone and gravel are usually measured in wheelbarrows or in a bottomless box similar to Fig. 10, p. 33. An ordinary wheelbarrow load is about 2 cubic feet.

When possible a concrete mixer should be used, as the resulting concrete is much more uniform. However, for small jobs, hand mixing is generally cheaper and more convenient.

In hand mixing the amount mixed at one time should not ordinarily exceed one cubic yard. A batch requiring 3 or 4 bags of cement is convenient.

Six turnings are usually necessary to secure a thorough mixture, three of these being dry with sand and cement and the other three being wet with the stone added. A turn consists in lifting the mass with a shovel and depositing it in another place with a spreading motion. Square pointed, short-handled shovels should always be used for mixing concrete.



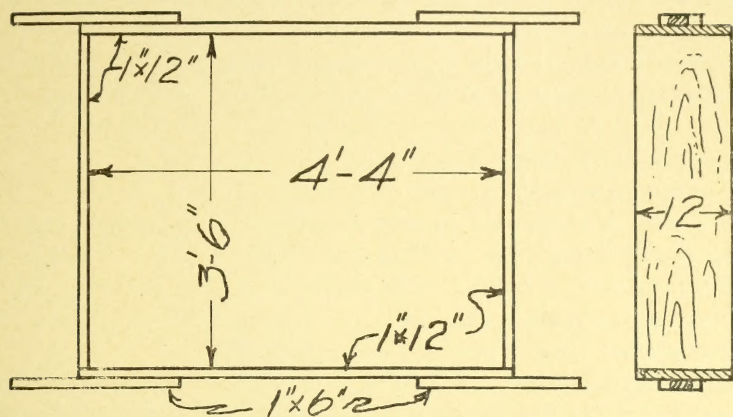


FIG. 10.—Measuring box for a batch of 1:2:4 concrete containing four bags of cement. Fill level full of stone; half full of sand.

Concrete should be mixed wet, especially if much reinforcing steel is used. Wet mixed concrete will slowly flatten out when piled up. Plenty of water should be used in mixing, but it should not be dashed on. It is well to use a definite number of pails of water for each batch. A good running board should always be provided for wheeling material to the mixing board. A good mixing board is 8x12 feet in size, the floor being laid so that shoveling will be along the grain of the wood.

*Placing:* The concrete is generally wheeled in barrows to the forms. A 2"x12" running board on a gentle incline should always be provided when possible. If the walls are high and thin buckets are sometimes used to convey the concrete, but this should be avoided. It is sometimes convenient to use a trough or chute or to shovel directly from the mixing board into the forms.

All blocks, sticks, shavings, etc., should be swept up and removed and all the reinforcement in place and thoroughly wired before beginning to place the concrete.

While the concrete is being placed it should be lightly tamped and thoroughly spaded back from the forms to prevent pockets and exposed rock on the faces of walls. A hoe with the blade straightened out in line with the handle makes a good tool for spading concrete.

*Forms:* Forms must be used to support the concrete until it has set. The time of setting varies with the quality of the cement, the condition of the weather (a longer time being required in cold, wet weather), and amount of water used in mixing. Forms must be tight enough to prevent leakage, strong enough not to deflect, and sufficiently well braced not to be pushed out of shape.

Forms are usually constructed of boards held in place by studs. Pine boards planed on one side and preferably of green lumber may be used. For surfaces which are to be visible, tongue and groove or ship-lap lumber is desirable. Sheet metal forms are sometimes used, especially when the forms are to be used over a number of times, and for small culverts they are reasonably cheap, durable, and very satisfactory.

One or two inch planks are generally used for sheathing. If one inch lumber is used it should not be over 8 inches wide in order to prevent cupping and splitting from swelling and shrinking. For ordinary culvert forms on country roads 2 inch plank 10 to 12 inches wide will be found most satisfactory. They will not warp, may be used over several times and require fewer studs than one inch lumber.

Studs should be spaced from 18 to 24 inches for one inch sheathing and from 3 to 5 feet for two inch sheathing. The spacing is dependent upon the wetness of the concrete, the thickness of the wall, and the finish desired on the surface. For surfaces which are to be covered with earth the spacing may be increased. Studs are usually 2"x4" or 2"x6" lumber for one inch sheathing depending on the height of the form and the spacing. For two inch sheathing, 2"x6", 4"x4", 3"x6" and sometimes 4"x6" lumber is used.

The carpenter work may ordinarily be done by unskilled labor, but on large jobs it will generally pay to use an experienced carpenter. It

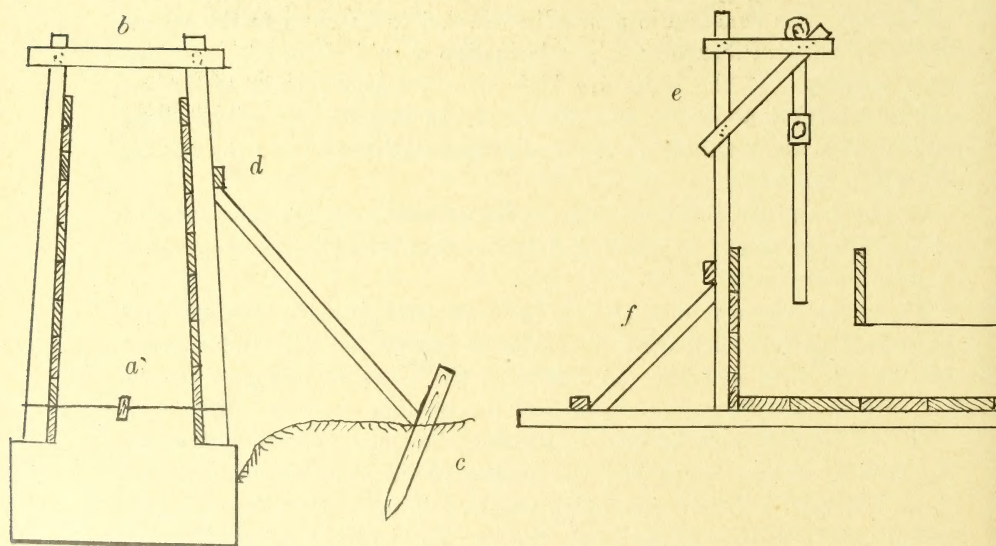
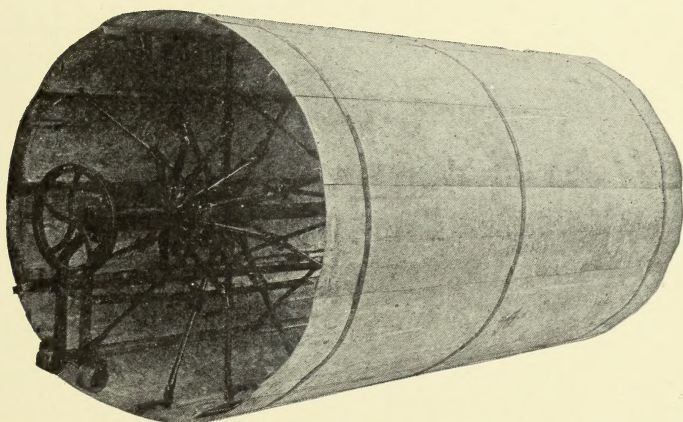


FIG. 11.—Methods of bracing forms. (a) Wired forms; (b) Cross-brace; (c) Brace against studs; (d) Cleat for brace; (e) Support for pipe rail; (f) Brace for side forms.





Collapsible Metal Form for Concrete Pipe Culvert. (The diameter may be varied from 20 to 48 inches.)

(Courtesy Merillat Culvert Core Co., Winfield, Iowa.)





is well to make the joints of the sheathing slightly open to prevent cupping and when the wet concrete comes in contact with the forms.

Small nails (6 or 8 d. for one inch and 10 or 12 d. for two inch sheathing) should be used to prevent the sheathing from splitting when taking down the forms.

If forms are to be used several times they should be given a good coat of crude oil, grease, or soft soap. When not greased they must be thoroughly wet several times before placing the concrete to prevent sticking, and to swell them as much as possible.

Thorough bracing is essential in securing good results. For ordinary wall forms frequent wiring is necessary to prevent spreading, especially when the forms are very high. These wires are twisted tight against wooden stretchers which are removed as the concrete reaches them. No. 9 wire is generally used for wiring forms.

Fig. 11, p. 34, illustrates several good methods of bracing the forms.

*Steel:* Rods for reinforcing concrete may be plain or deformed. Deformed rods are made in numerous shapes and have the advantage of making a better bond with the concrete, but they are more expensive than plain rods. Expanded metal and wire mesh are used for thin work and are especially valuable when reinforcing the face of the wall to prevent cracking from changes in temperature. Table VIII gives data in regard to reinforcing steel.

TABLE VIII—AREAS AND WEIGHTS OF RODS

Diameter (Ins.)	Square Rods		Round Rods	
	Area (Sq. Ins.)	Weight per Foot (Lbs.)	Area (Sq. Ins.)	Weight per Foot (Lbs.)
$\frac{3}{8}$	.1406	.478	.1104	.376
$\frac{1}{2}$	.2500	.850	.1963	.668
$\frac{5}{8}$	.3906	1.328	.3068	1.043
$\frac{3}{4}$	.5625	1.913	.4418	1.502
$\frac{7}{8}$	.7656	2.603	.6013	2.044
1	1.0000	3.400	.7854	2.670
$1\frac{1}{4}$	1.2656	4.303	.9940	3.380
$1\frac{1}{2}$	1.5625	5.313	1.2272	4.172

Reinforcing rods are sold by the pound. The price of rods is usually based on a  $\frac{3}{4}$  inch diameter and over, diameters smaller than  $\frac{3}{4}$  inch are relatively more expensive. Expanded metal and mesh reinforcement is generally sold by the square foot.

Rods having a diameter less than  $\frac{3}{4}$  inch may be cut cold with a cold chisel. Larger diameters are preferably heated in a portable forge before cutting. Heating also facilitates bending large rods. Fig. 12 illustrates a convenient way of making short bends.

In placing the steel in the forms it should be wired together at frequent intervals with small wire (generally No. 12 gauge) to prevent displacement when pouring the concrete. To insure the accurate placing of the steel small spacing rods ( $\frac{1}{4}$  to  $\frac{3}{8}$  inch) are sometimes used. The rods should in no case be closer than one inch to the forms. In flat slabs after the steel is wired together it may be supported by small wooden blocks which are removed as the concrete is placed. Plate XVI illustrates a method of supporting the steel and the running board for wheelbarrows.

*Protection During Setting:* Immediately after placing the concrete it should be covered with earth or boards to keep it from drying too quickly if exposed to the sun. If possible, it should be sprinkled with water every evening for several days.

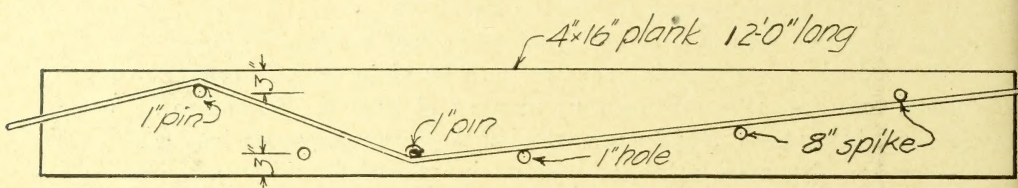


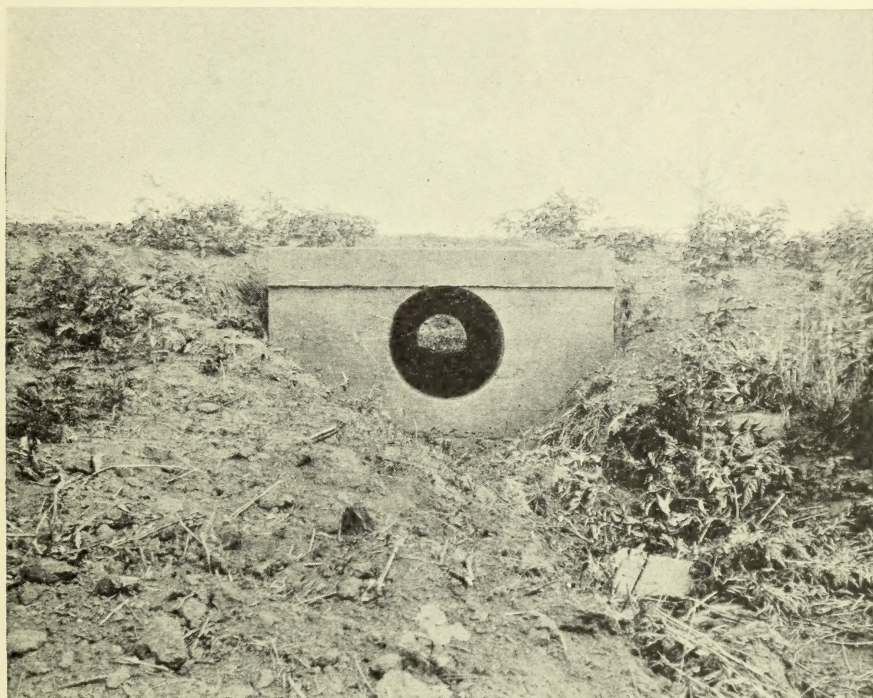
FIG. 12.—Board for bending reinforcing steel.

In this State freezing weather will not ordinarily come often enough or be severe enough to require special precautions. When freezing weather is expected the concrete should be covered with clean straw, sand or other suitable material. The addition of about two pounds of salt dissolved in the mixing water for each bag of cement will lower the freezing point of the concrete.

*Removal of Forms:* The weather, the brand of cement used, and the amount of water used in mixing will affect the length of time the forms should remain in place. As a rule, on reinforced work they should remain as long as possible. Ordinarily from 7 to 14 days should be allowed for most reinforced work, although forms on exposed faces may be removed earlier if the concrete has no load to support. Forms should remain under beam bridges 28 days, if possible. No heavy loads should be allowed to cross a bridge having a span over 10 feet within a month after placing the concrete, unless the forms supporting the floor are in place.

*Finish:* On exposed faces, where possible, the forms should be removed after 48 hours and bumps rubbed or chiseled off and pockets filled with cement mortar of the same proportions as the mortar in the concrete. In finishing the tops of wing and parapet walls the concrete should be tamped until the mortar flushes to the surface. A straight





Concrete Pipe Culvert, Made with a Collapsible Form.





edge and short triangular strip of wood may be used to smooth the top and bevel the edges.

### CONCRETE WATERWAYS

Plain and reinforced concrete may be used in all shapes of waterways which usually occur on country roads. The shape to use, whether a pipe, box, slab, or arch will usually depend on the location of the structure.

*Staking Out:* In laying out a waterway the length should first be determined. This is largely a matter of personal choice, but as a general rule structures having 25 square feet area of waterway or less should extend completely across the graded width, no guard rail being necessary; and those having over 25 square feet area of waterway should not be less than 15 feet long, preferably 20 feet. Fig. 13 illustrates a method of determining the length of small culverts illustrated in this bulletin.

The foundations are laid out according to the dimensions on the plans. A small stake is placed at each corner and a light cord is stretched between the stakes to serve as a guide in excavating the earth. The character of the soil sometimes makes it necessary to excavate beyond the width required for the concrete. The earth bottom should be trued with a straight edge and level. If footings are used, small stakes may be placed on the sides of the trench with their tops level with the top of the footing and the concrete brought up to them. It is important that the top of the footing should be true, as it is difficult to set the forms on any uneven surface.

A tape, straight edge, and good carpenter's level are usually all the tools necessary to do the staking out. It is convenient to remember that the sides of a right triangle are in the ratio 3:4:5. For example, when the zero and 12 ft. marks on the tape are held together, and the 3 ft. and 7 ft. marks held along a wall the zero is perpendicular to the wall.

Except in waterways, requiring a guard rail it is neither necessary nor advisable that the tops of both parapet walls be at the same elevation.

*Methods of Design:* All the culverts and bridges illustrated in this bulletin are designed to support a 15-ton road roller. 1:2:4 concrete is used for all slabs, beams, parapet walls, and reinforced bottoms. 1:2½:5 concrete is used in side walls and foundations. The concrete in beams and slabs is designed to be stressed to 700 pounds per square inch. The reinforcing steel is computed for plain square bars of mild steel with an allowable stress of 16,000 pounds per square inch. Round,

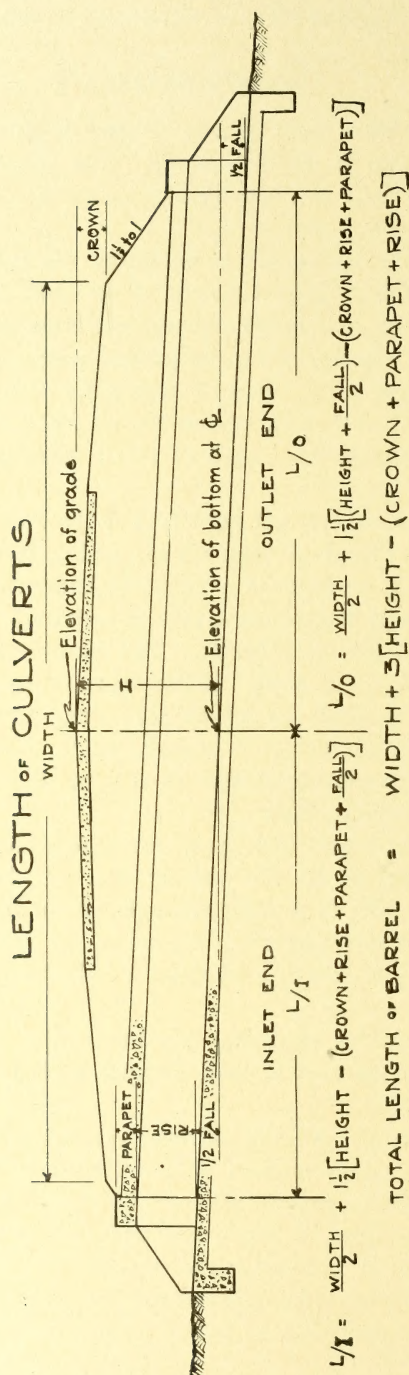
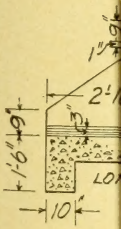
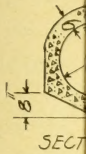


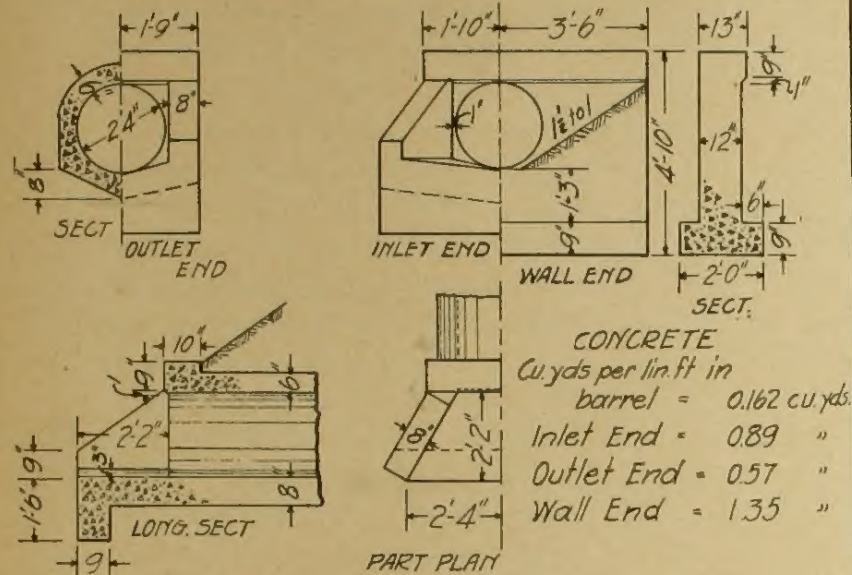
FIG. 13.—Method of determining length of small culverts.



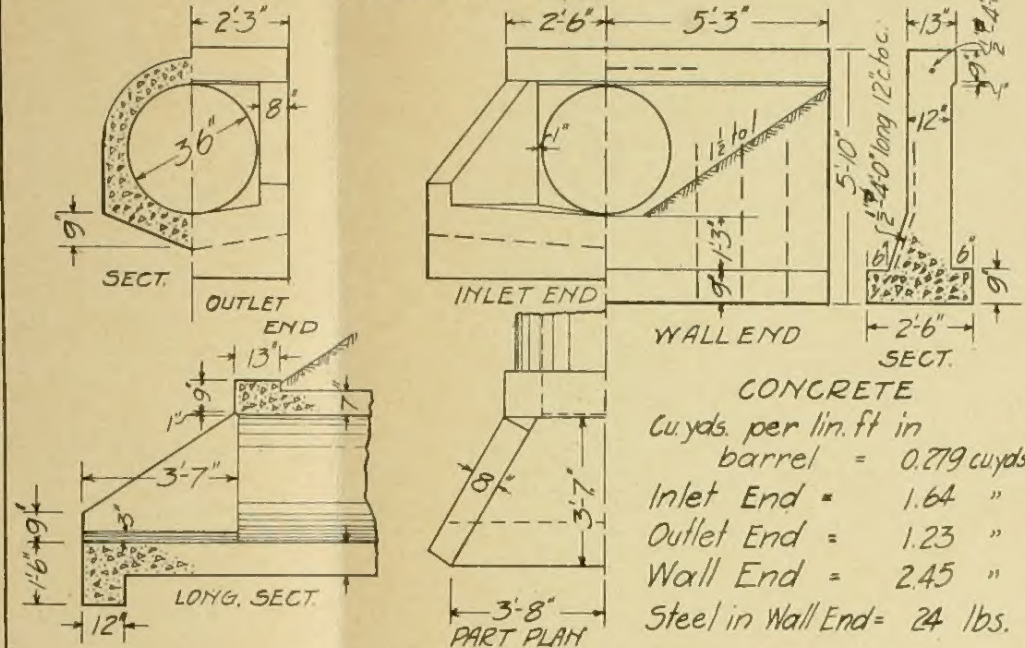




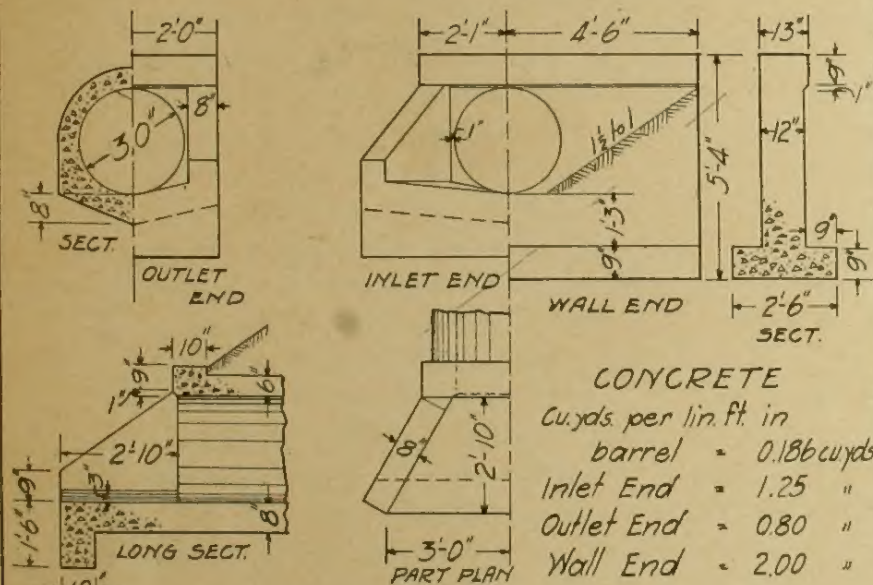
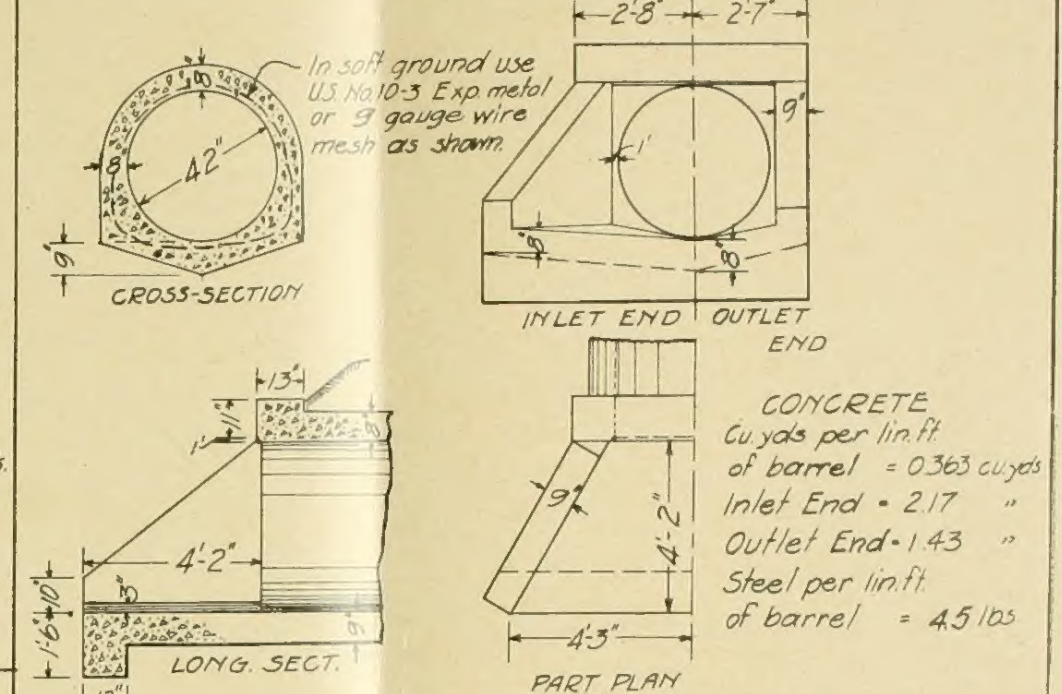
24 IN CIRCULAR CULVERT  
Area 3.14 sq. ft.



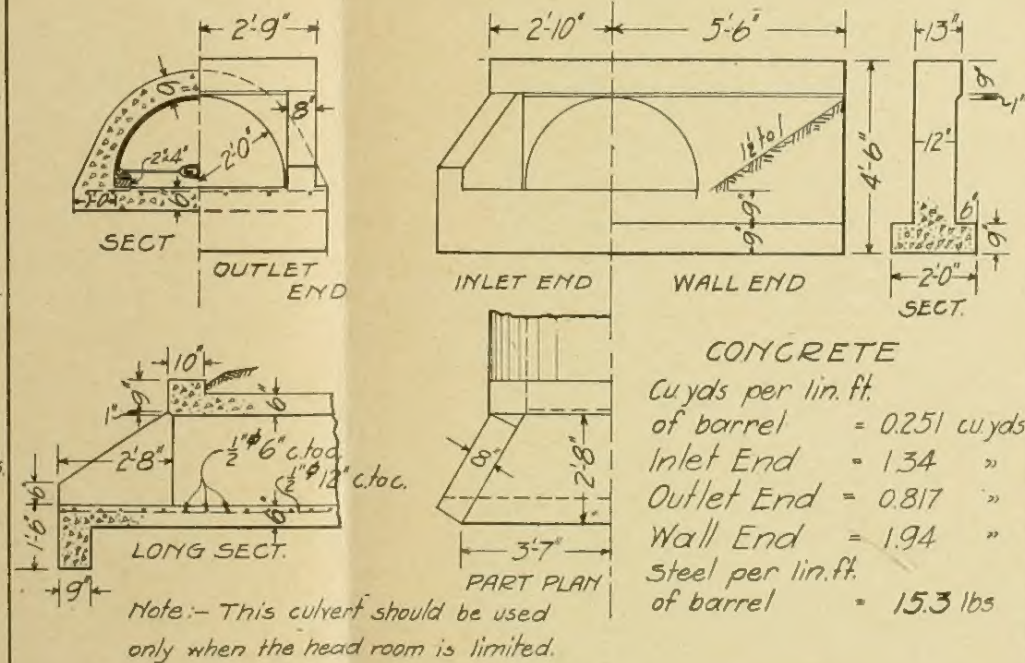
36 IN CIRCULAR CULVERT  
Area 7.06 sq. ft.



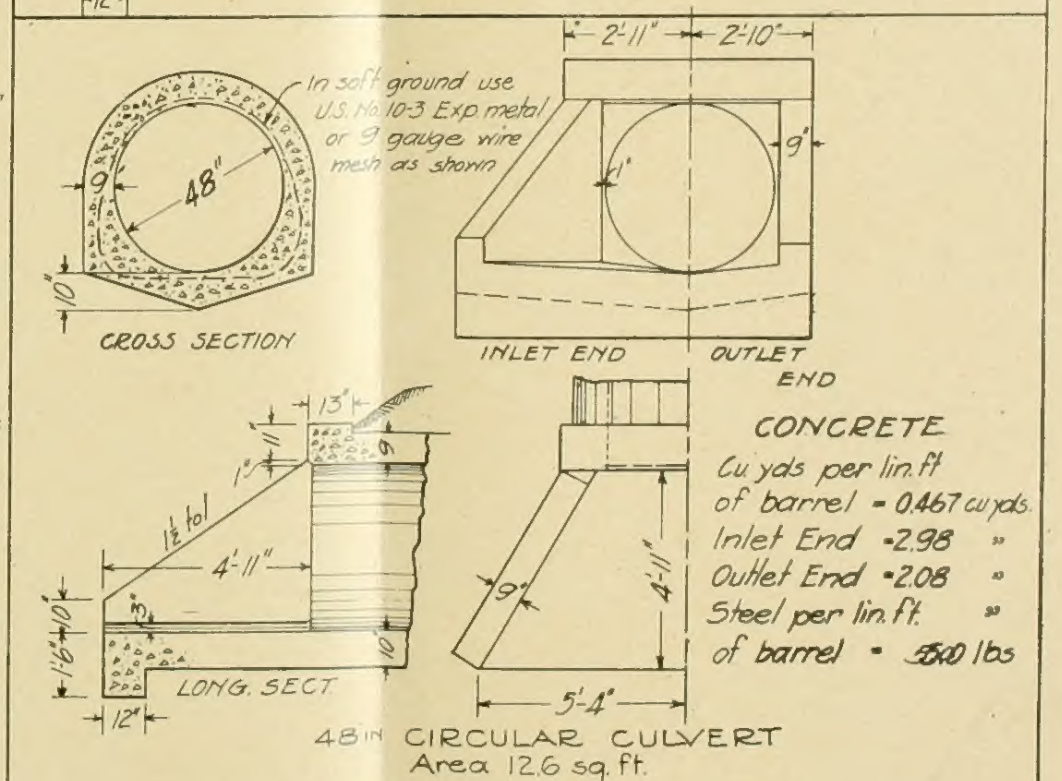
42 IN CIRCULAR CULVERT  
Area 9.62 sq. ft.



30 IN CIRCULAR CULVERT  
Area 4.96 sq. ft.



48 IN SEMI-CIRCULAR CULVERT  
Area 7.0 sq. ft.



48 IN CIRCULAR CULVERT  
Area 12.6 sq. ft.



twisted, or deformed bars may be used in place of these, provided the cross-sectional area of steel remains the same.

*Pipe Culverts:* Several designs for solid concrete pipe are shown in Plate VI. In building these a collapsible metal form similar to the one illustrated in Plate IV is very convenient.

The form for the half-round culvert should be made of No. 10 gauge sheet metal with a  $1\frac{1}{2}'' \times 1\frac{1}{2}''$  angle riveted on the edges, rods with turnbuckles 4 feet apart serving to spring the form. A beveled  $2'' \times 4''$  wooden strip must be placed under each edge in order to strike the form. A piece of No. 10 gauge sheet metal cut to fit the top of the form will serve for an end wall form.

In building these culverts the bottom is put in level and allowed to set, being careful to have it true from end to end. The form is then placed and the concrete deposited for the length of the section. After 24 hours the form may be withdrawn and set for the next section of the pipe. Ordinarily no wooden forms are necessary except for the end walls.

*Box Culverts:* A type of box culvert is illustrated in Plates X and XI. Plates VIII and XI are photographs of various types of end-walls for these culverts. Expanded metal or triangular wire mesh reinforcement may be used in the place of rods. These culverts are provided with baffle walls which, in some cases, may be omitted at the upper end. At the lower end it may sometimes be necessary to increase the depth of the baffle wall or to place a baffle wall under the wings as well as at the end. In striking the inside forms the joists supporting the top of the culvert are knocked out, the top forms drop down and the side forms spring in. It is often possible to excavate the trench to the exact size and shape of the culvert, doing away with outside forms. However, the side walls must be thicker when this is done.

*Slab Culverts and Bridges:* Plate XIV gives a design for various sizes of slab culverts and bridges. Plate XV illustrates the forms for a bridge of this type. A convenient way of supporting the form for the slab is to use light I-beams spaced about 4 feet, which may project through the abutments, resting on wedges set in an opening left in the abutment. When the forms are removed the hole is filled with concrete. A boulder cut-off wall may sometimes be required at both ends of the culvert to prevent undermining the abutments, and in very bad soils it is well to build this wall of concrete. The abutment walls should be carried to a solid foundation, never less than 2 feet below the bed of the stream.

*Slab and Beam Bridges:* Slab and beam bridges illustrated in Plate XVIII are economical for spans exceeding 12 feet. Care must be taken

with the foundations of these bridges since the weight of the concrete is the greatest load the bridge has to carry. The footing must always be carried to a solid bed and in many cases piles will be necessary. The beams and slabs must be laid at the same time, using care not to disturb the steel. When several spans are used, the total length exceeding 80 to 90 feet, expansion joints are necessary and may be put in as illustrated in Plate XVIII. When the beams are continuous over piers reinforcement must be put in the tops of the beams, except at expansion joints. The beams are designed as simple beams, but some reinforcement in the top over the supports is necessary to prevent cracks when they act as continuous beams.

The posts under the forms must have a good foundation. The load on each post in a 30 ft. span amounts to about 2,500 pounds.

For spans longer than about 30 feet, bridges composed of two girders with the floor suspended between them are economical. These bridges, however, require a special design for each case.

Piers must be carried to a solid foundation, never less than 3 feet below the bed of the streams unless the foundation is rock. The piers carry twice the load of the abutments, hence the foundation must be much more solid. Piles will often be required under the piers. The solid type of pier is easier to build and is to be preferred unless the height is excessive. Piers may be built slightly higher than the abutment, giving the bridges a small slope.

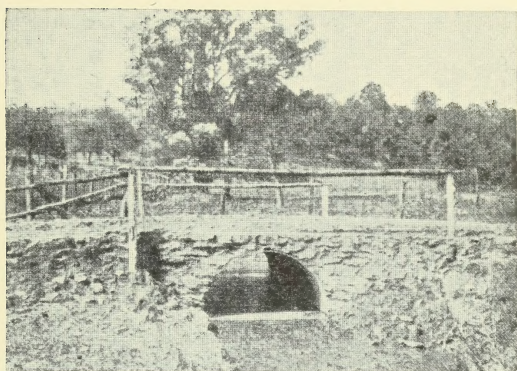
If the length of the bridge exceeds 50 feet it is well to put a drain pipe covered with an iron grating through the floor near the end of the bridge to prevent the drainage water from the bridge washing the earth from around the wings.

*Arch Culverts and Bridges:* Plate XX gives the design of several small arch culverts or bridges. With these structures it is imperative that the foundation be absolutely solid. If the foundation is at all poor it is best to use a flat top structure. The abutments are put in first and the arch divided into circular sections and one section laid at a time. At least 28 days should be allowed for the concrete to set before striking the arch forms.

Arch culverts are expensive to build, but they have a very pleasing appearance.

*Guard Rails:* Either pipe or solid concrete rails may be used on the concrete structures described. Pipe guard rails are cheap, slightly, and on the whole, satisfactory, although they require some maintenance. They may be supported while the concrete is being placed, as shown in Fig. 11, p. 34. They should be given a thin coat of red lead and oil, fol-

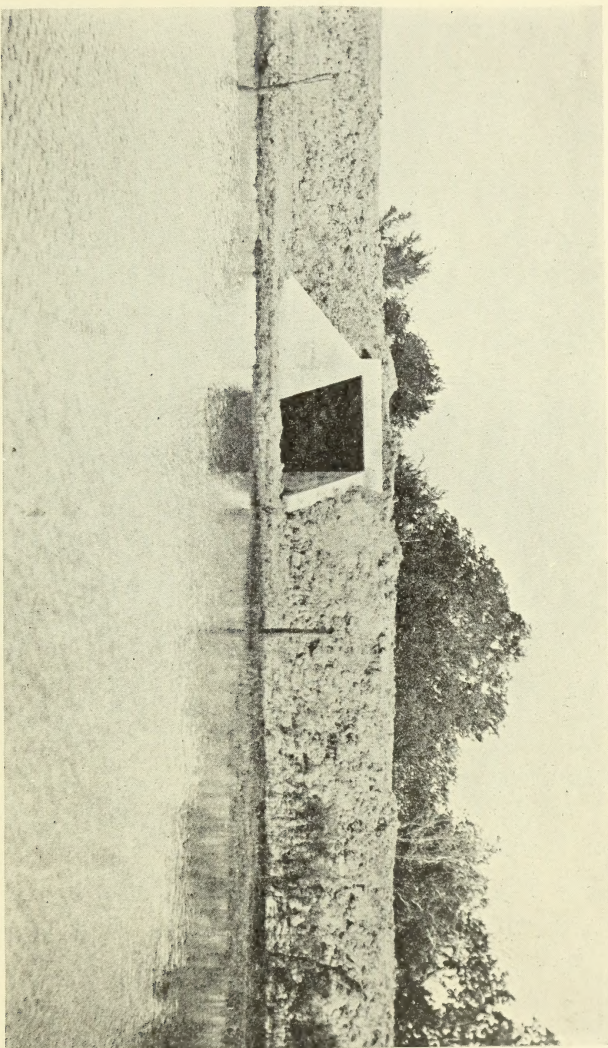




Corrugated Metal Pipe Culverts.  
(Note methods of protecting ends.)







Inlet end of a Concrete Box Culvert.





lowed by two good coats of white lead and oil after the bridge is completed. Pipe railing will cost about \$0.50 per linear foot of single rail.

Concrete rails are very sightly but are difficult to construct and very expensive and are not recommended for ordinary country work.

#### COST OF CONCRETE.

The cost of concrete in small structures on country roads will vary somewhat from its cost in town or on large jobs. A main point of difference is probably in the cost of materials delivered on the job. Another difference comes in the delay and expense of continually moving the plant from one point to another.

The cost of hauling material to the work will be near 30 cents per cubic yard for every mile it must be hauled. An ordinary wide tread, slat bottom wagon bed containing a cubic yard is 38"x8'-6"x12" in size, inside dimensions, and is usually as much as the average team can handle over bad roads. An inch added to the height of the side boards increases the capacity of the bed .083 cubic yard.

Loading sand or gravel into a wagon bed will cost from 7 cents to 10 cents per cubic yard where shovels are kept busy, but may cost as high as 15 cents when the driver loads his own wagon.

A small gang with four good men mixing and one man shoveling material into barrows and putting on water, should mix and wheel 40 or 50 feet from 8 to 10 batches or 6 to 8 cubic yards of 1:2½:5 concrete, assuming a batch contains one barrel (four bags) of cement. The cost of this mixing will vary from 80 cents to \$1.15 per cubic yard.

On small jobs where new forms are required, the cost of framing and erecting the forms will never be less than \$12 to \$15 per 1,000 ft. B.M. of lumber used, due to the large amount of cutting and fitting necessary. On larger jobs the cost may be reduced to \$8 to \$10 per 1,000 ft. B.M. These costs are much less when old forms are used. Lumber will cost from \$22.50 to \$30.00 per 1,000 ft. B.M. Steel rods will cost from 1¾c. to 2¼c. per pound, delivered in most sections of the State.

The labor cost of bending and placing steel is about ½ cent per pound. This will be increased slightly if many rods greater than ¾ inch in diameter must be cut cold.

The cost of excavating for foundations will vary from 50 to 80 cents per cubic yard in dry earth and will generally vary between \$1.50 and \$3.00 per cubic yard where small puddle cofferdams not over 6 feet deep must be built.

Tearing down forms, finishing and cleaning up around the work will usually cost about 10 cents per cubic yard of concrete.

The cost of moving the plant from one job to another will usually be from \$10 to \$20, where the plant is not moved over five miles.

The cost data below is for a small 4x5 box culvert, 26 feet long, built according to the designs in this bulletin and illustrated in Plate VIII.

The work was done by a regular county concrete gang, composed of a foreman, seven men and two teams with drivers, and was completed in four days of 10 hours each. The excavation was light, but the soil was of a hard, black nature that was hard trimming. Water for mixing had to be hauled two miles.

Sand gravel was used for aggregate in the concrete. The gravel contained a slight excess of sand and worked up in the proportions given. Mixing was done by hand with negro labor. Twisted square steel bars were used for reinforcing.

#### LABOR.

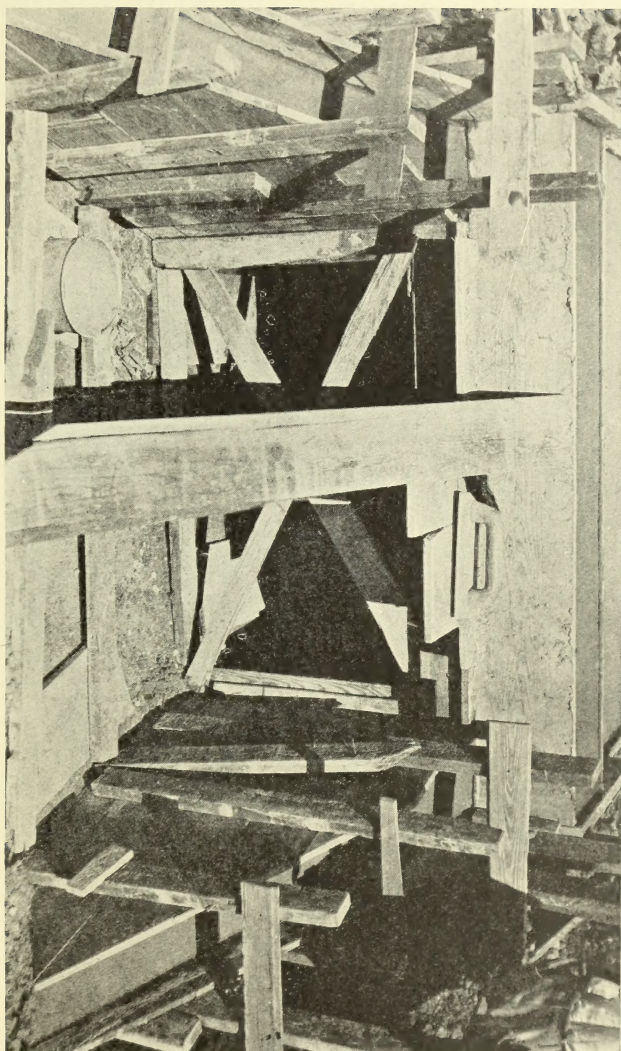
Foreman, 40 hrs. @ 25c.....	\$10.00
Culvert excavation, 9 cu. yds. @ 80c.....	7.20
Labor on forms .....	14.00
Mixing and placing, 120 hrs. @ 15c.....	18.00
Hauling water, 20 hrs. @ 30c.....	6.00
Cutting and placing steel, 10 hrs. @ 15c.....	1.50
Cleaning up and removing forms, 10 hrs. @ 15c.....	1.50
	<hr/>
	\$58.20
50% salvage on form lumber.....	7.00
	<hr/>
	\$51.20
Moving on and off job.....	10.00
	<hr/>
Total labor at culvert.....	\$61.20

#### MATERIAL (laid down at culvert).

Cement, 26 bbls. @ \$1.80.....	\$46.80
Hauling cement, 12½ hrs. @ 30c.....	3.75
Gravel, 18½ cu. yds. @ \$1.10 f. o. b. cars Ennis, Tex.....	20.35
Hauling, 18½ cu. yds., 46 hrs., @ 30c. (75c. per cu. yd.)....	13.80
Steel, 1,072 lbs. @ 2½c.....	26.80
Hauling steel, 2 hrs. @ 30c.....	.60
Lumber, 1,000 ft. B. M. @ \$25.00.....	25.00
Hauling lumber, 3 hrs. @ 30c.....	.90
	<hr/>
	\$138.00
75% salvage on form lumber.....	18.75
	<hr/>
Total cost of material at job.....	119.25
	<hr/>
Total cost of job .....	\$180.45

Cost per cu. yd. of concrete in place exclusive of culvert excavation..	\$9.37
Cost per cu. yd. of concrete in place exclusive of excavation and steel	\$7.85

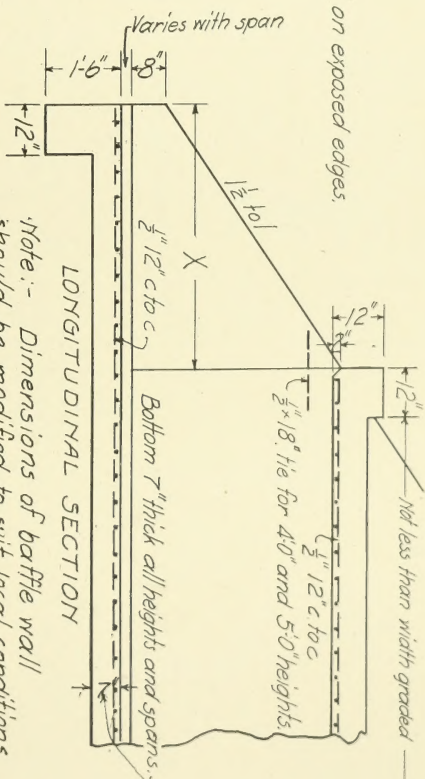




Forms for a Concrete Box Culvert End.







Note:- Dimensions of baffle wall should be modified to suit local conditions.

HEIGHT		SPAN		THICKNESS ABUTMENT	THICKNESS SLAB	LENGTH WING (X)	1/2 WIDTH WING END (Y)	BOX SECTION			INLET END	OUTLET END					
FT	FT	INS	INS	INS	FT INS	FT INS		STEEL									
					Size	Size		TOP	BOTTOM	DOWELS	WEIGHT LIN. FT.	CONCRETE LIN. FT.	CONCRETE	STEEL	CONCRETE	STEEL	
1 1/2 x 3	8"	7"	1'-4"	2'-3"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				246	0.261	0.60	2.5	0.61	2.2	
2 x 2	8"	6"	2'-2"	2'-5"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				191	0.234	0.69	2.8	0.62	2.6	
2 x 4	8"	7"	2'-1"	2'-8"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				246	0.285	0.80	3.5	0.75	3.0	
2 x 4	8"	8"	2'-0"	3'-2"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"			*	365	0.345	0.92	4.1	0.87	3.5	
3 x 3	9"	7"	3'-7"	3'-7"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				246	0.360	1.37	5.0	1.19	4.0	
3 x 4	9"	8"	3'-6"	4'-1"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				365	0.421	1.52	7.5	1.26	6.0	
4 x 4	9"	9"	3'-5"	4'-6"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				562	0.478	1.64	10.0	1.41	9.5	
4 x 4	10"	8"	5'-0"	4'-11"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				365	0.515	2.27	12.0	1.73	9.5	
4 x 5	10"	9"	4'-11"	5'-4"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				562	0.580	2.50	13.0	1.91	10.9	
5 x 5	10"	9"	6'-5"	6'-3"	1'-0 1/2"	1'-0 1/2"	1'-0 1/2"				562	0.644	3.35	15.1	2.45	13.2	

Concrete Box Culverts.





The quantities were as follows:  $14\frac{1}{2}$  cu. yds. of 1:3:5 concrete; 4 cu. yds. of  $1:2\frac{1}{2}:4$  concrete; 432 lbs. of  $\frac{3}{4}$  in. steel; 640 lbs. of  $\frac{1}{2}$  in. steel; and 1,000 ft. B.M. of lumber.

In estimating the cost of work it is well to use a form similar to that shown for the cost data above. When it is desired to find the probable cost per cubic yard of concrete Table VII is convenient. The various amounts of each material are determined and multiplied by their cost per cubic yard laid down at the job, these costs varying for almost every case. The other costs which are more nearly constant may then be added as shown below.

For example, if 30 cu. yds. of  $1:2\frac{1}{2}:5$  concrete is needed and the cost of material laid down at the job is as given, its cost per cubic yard may be approximately estimated as follows:

Cement, 1.37 bbls. @ \$1.50.....	\$2.06
Sand, 0.48 cu. yd. @ \$0.50.....	.24
Stone, 0.96 cu. yd. @ \$0.50 to \$1.50.....	\$0.50 to 1.45
Mixing and placing .....	1.00
Forms (labor and material).....	.50 to .75
Hauling material .....	.50 to 3.00
Foreman, moving, cleaning up, etc.....	1.00
<hr/>	
Plain concrete (per cubic yard).....	\$5.85 to \$9.50
Reinforcing steel (0.5% to 0.8%), 66 to 106 pounds @ 3c. per pound in place .....	2.00 to 3.20
<hr/>	
Reinforced concrete per cubic yard.....	\$7.85 to \$12.70

It will be seen that the cost of hauling and the cost of stone or gravel will greatly influence the cost of the concrete.

#### I-BEAM BRIDGES.

Steel I-beam bridges (with plank floors) resting on stone or concrete abutments may be used to advantage in places where the span is long and the money available is small. They are, however, not as durable or as satisfactory as solid concrete structures. Concrete floors are sometimes used, but as a rule it is better to use a plank floor or to build the entire bridge of concrete, omitting the I-beams.

Fig. 14 gives a design similar to that used by the American Bridge Company and Table IX gives the sizes and amounts of material in these bridges. Material for bridges of this type will cost between 3c. and 4c. per pound, delivered.

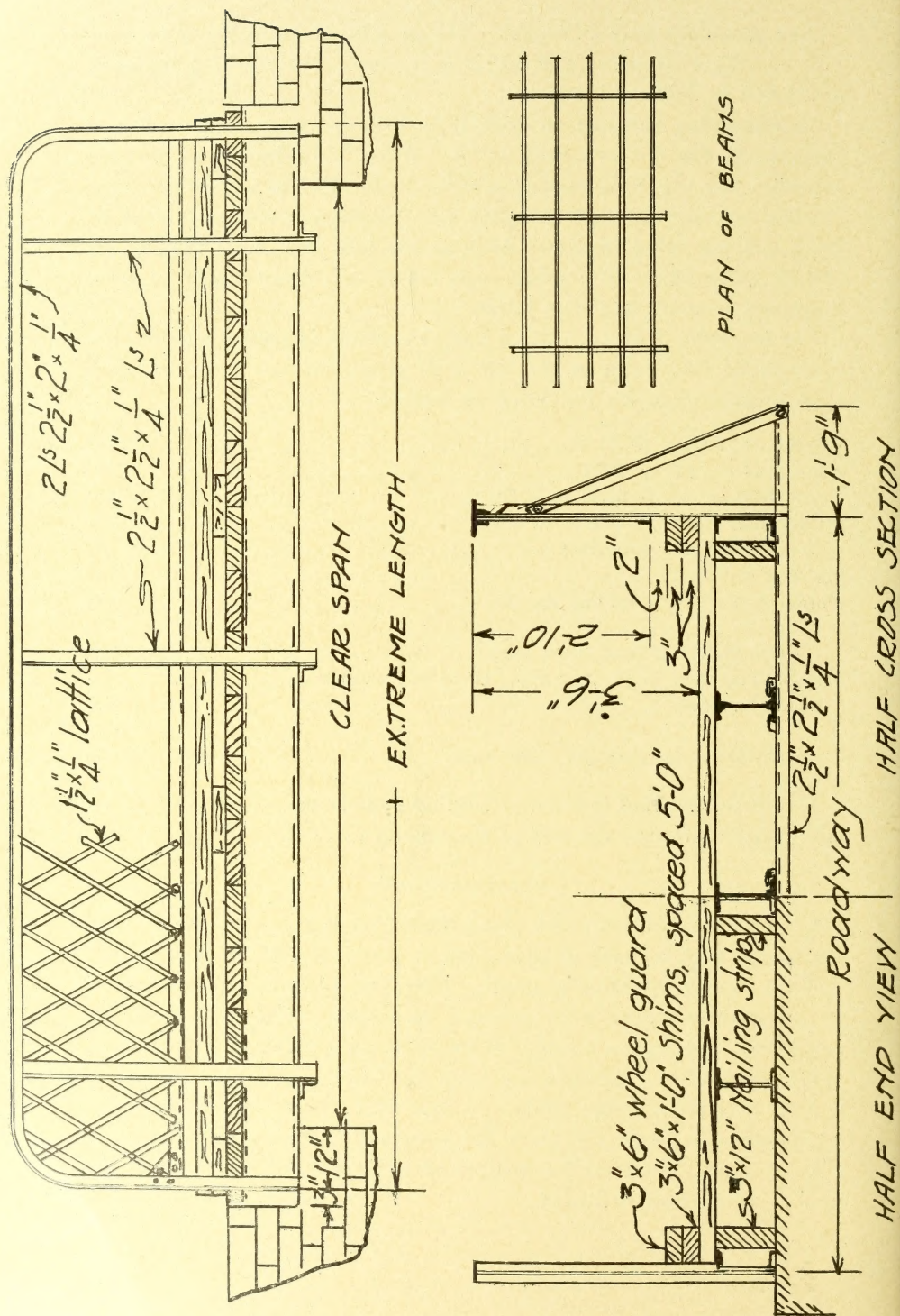


FIG. 14.—Steel I-Beam bridges. (American Bridge Co.)



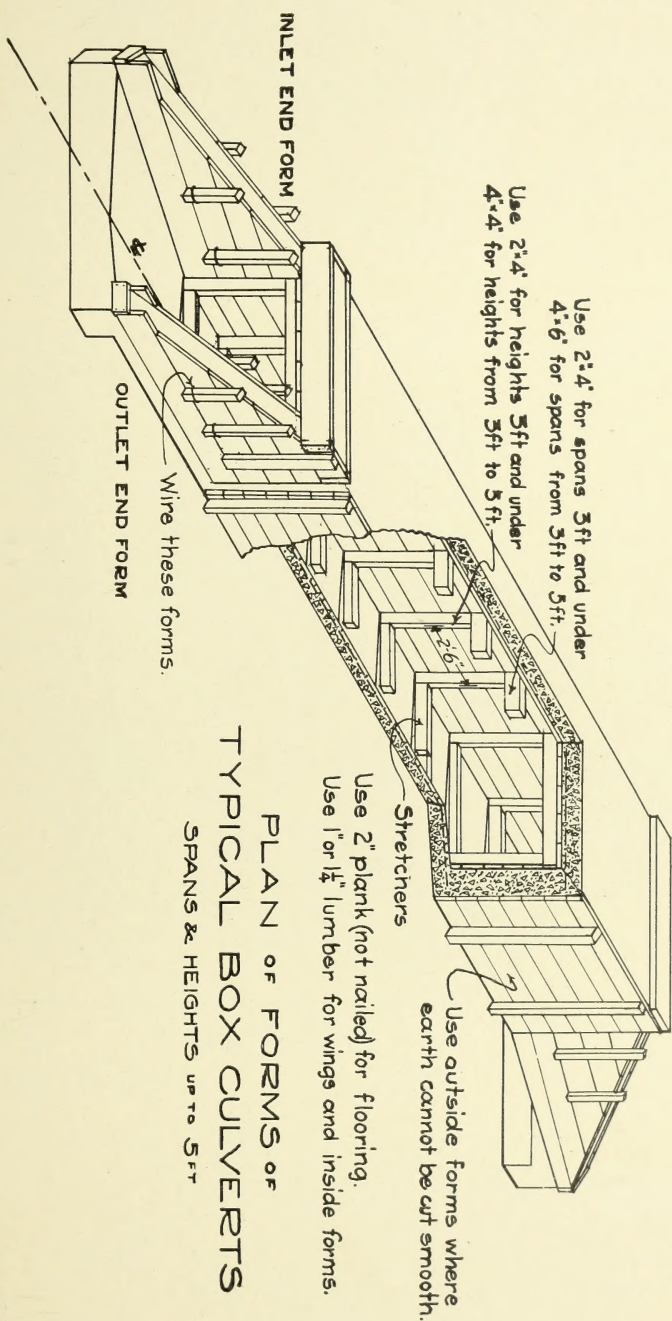






TABLE IX—BEAM BRIDGES, (American Bridge Company)

Maximum Clear Span Ft.	Size of Joint Used	Items	Width of Roadway and Number of Joists Used					
			12' 0'' 2/s 3 Is	14' 0'' 2/s 4 Is	16' 0'' 2/s 5 Is	18' 0'' 2 6 Is	20' 0'' 2/s 7 Is	
14'-0''...	6'' Is-12¼ lbs. ....	Joists, lbs. per lin. ft. ....	53	65	77	90	102	
	6'' [s-8 lbs. ....	2 wall channels. ....	260	300	340	380	420	
		1 set bracing. ....	150	160	170	180	190	
		Field bolts and clips. ....	51	55	59	63	67	
		Joists, lbs. per lin. ft. ....	65	80	95	110	125	
17'-0''...	7'' Is-15 lbs. ....	2 wall channels. ....	265	305	345	385	425	
	7'' [s-9¾ lbs. ....	1 set bracing. ....	155	165	175	185	195	
		Field bolts and clips. ....	57	61	65	69	73	
		Joists, lbs. per lin. ft. ....	77	95	113	131	149	
		2 wall channels. ....	270	310	350	390	430	
20'-0''...	8'' Is-18 lbs. ....	1 set bracing. ....	160	170	180	190	200	
	8'' [s-11¼ lbs. ....	Field bolts and clips. ....	65	69	73	77	81	
		Joists, lbs. per lin. ft. ....	90	111	132	153	174	
		2 wall channels. ....	275	315	355	395	435	
		1 set bracing. ....	165	175	185	195	205	
23'-0''...	9'' Is-21 lbs. ....	Field bolts and clips. ....	67	72	77	82	87	
	9'' [s-13¼ lbs. ....	Joists, lbs. per lin. ft. ....	105	130	155	180	205	
		2 wall channels. ....	280	320	360	400	440	
		1 set bracing. ....	170	180	190	200	210	
		Field bolts and clips. ....	75	80	85	90	95	
27'-0''...	10'' Is-25 lbs. ....	Joists, lbs. per lin. ft. ....	136	167	199	230	262	
	10'' [s-15 lbs. ....	2 wall channels. ....	290	330	370	410	450	
		2 sets bracing. ....	350	370	390	410	430	
		Field bolts and clips. ....	118	129	140	151	162	
		Joists, lbs. per lin. ft. ....	146	181	216	251	286	
30'-0''...	12'' Is-31½ lbs. ....	2 wall channels. ....	290	330	370	410	450	
	12'' [s-20½ lbs. ....	2 sets bracing. ....	350	370	390	410	430	
		Field bolts and clips. ....	118	129	140	151	162	
		Joists, lbs. per lin. ft. ....	146	181	216	251	286	
		2 wall channels. ....	290	330	370	410	450	
31'-0''...	12'' Is-35 lbs. ....	2 sets bracing. ....	350	370	390	410	430	
	12'' [s-20½ lbs. ....	Field bolts and clips. ....	118	129	140	151	162	
		Joists, lbs. per lin. ft. ....	161	201	241	281	321	
		2 wall channels. ....	290	330	370	410	450	
		2 sets bracing. ....	350	370	390	410	430	
35'-0''...	12'' Is-40 lbs. ....	Field bolts and clips. ....	123	135	147	159	171	
	12'' [s-20½ lbs. ....	Joists, lbs. per lin. ft. ....	192	234	276	318	360	
		2 wall channels. ....	305	345	385	425	465	
		2 sets bracing. ....	360	380	400	420	440	
		Field bolts and clips. ....	138	151	164	177	190	
Lumber:	Ft. B. M. per lin. ft.	span. ....	40	46	52	58	64	

Floor: 3-inch oak plank.

Railing: Total weight of two sides=33 lbs. x length in feet + 100 lbs.

Extreme length of span=clear span + 2 feet, (ordinarily).

## MAINTENANCE OF CULVERTS AND SMALL BRIDGES

A certain amount of maintenance is necessary on all waterways. Earth must occasionally be filled in back of the wing walls, accumulations of drift must be removed from the mouth of small culverts and weeds which may spring up near the ends should be cut and removed. Minor repairs on permanent culverts, such as painting guard rails, must be attended to. These, however, may be included in the general maintenance of the road.

Wooden culverts and bridges must be looked after closely, especially the condition of the floor. If there are many wooden structures to maintain, the repairs are best made by one man detailed for the purpose.

## GENERAL SPECIFICATIONS

### GENERAL CLAUSES TO BE USED IN SPECIFICATIONS FOR HIGHWAY CULVERTS AND MASONRY BRIDGES.

All culverts and bridges shall be built to dimensions as shown on the plans or approved in writing by the engineer and shall conform to the lines and grades as furnished by the engineer.

### PIPE CULVERTS.

Pipe culverts will include all waterways of circular cross-section of whatever material constructed.

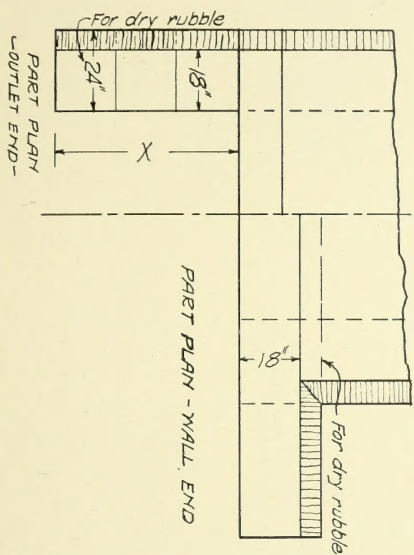
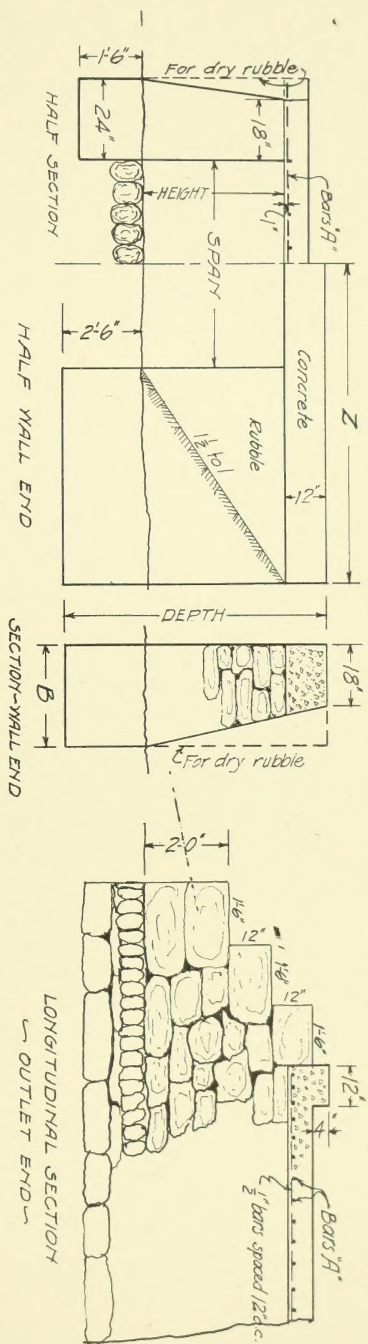
The price per foot for pipe culverts in place includes the cost of trenching and back-filling for the pipe and end walls and all incidental work, except the masonry ends; provided, however, that when the depth of the trenching exceeds five (5) feet all excavation necessary on account of additional depth shall be paid for by the cubic yard at the regular contract price for excavation. The ends of pipe culverts shall be protected by end walls, as shown on the plans or directed by the engineer, and will be paid for according to the amount of end wall masonry used.

If ordered by the engineer, concrete, crushed stone, sand or cinders shall be placed under and around the pipe, and shall be paid for at the regular price per cubic yard for such material. All back-filling shall be thoroughly tamped, in thin layers, up to the level of the sub-grade.

*Vitrified Pipe:* Vitrified clay pipe shall be "single strength," first quality, salt-glazed, free from blisters and cracks, straight and round, and have a well defined ring when struck with a hammer, or "double strength," second quality, well burned, and free from cracks.

In laying, the bottom of the trench shall be thoroughly tamped and small depressions cut so that the bottom of the bells will have no bearing. All joints shall be made of Portland cement mortar mixed in the proportion of one (1) part cement to three (3) parts clean sand, carefully filled in around the pipe and finished with a conical collar even





HEIGHT	SPAN	THICKNESS COVER STONE	CONCRETE (SING. UNIT)		STEEL WEIGHT (TOTAL)	ABUTMENTS CU YDS	WALL END		OUTLET END	
			THICKNESS	CU YDS.			CONCRETE	STEEL	CONCRETE	STEEL
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15	15
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99	99	99	99	99	99	99	99	99	99	99
100	100	100	100	100	100	100	100	100	100	100

Note: Quantities based on rubble laid in cement mortar.  
 \* Slab must extend across abutment top for dry rubble.





with the outer edge of the bell. Nothing but selected fine material, free from large stones, shall be used for back-filling under and around the pipe.

*Corrugated Metal Pipe:* Corrugated metal pipe shall be constructed of corrugated metal sheets of a form and quality approved by the engineer. Each sheet of metal in the pipe shall be stenciled by the mill, showing the mill at which the sheet was rolled, the kind or trade name of the metal, the size of the plate, and the gauge of the plate. The gauge of the metal and the size of sheet used for various diameters shall not be less than the following:

Diameter, inches	Gauge.	Length of Sheet, inches
12	16	39
15	16	48
18	16	58
24	15	76
30	15	96
36	14	115
42	14	133
48	12	76
60	12	96

*Rivets and Spacing:* Rivets shall be of metal approved by the engineer and shall be 5-16 inch in diameter. They shall be not less than  $\frac{3}{4}$  inch long for No. 12 gauge metal and not less than  $\frac{3}{8}$  inch long for metal lighter than No. 12 gauge. In all longitudinal joints rivets shall be placed at each corrugation (about two (2) inches apart). Circumferential rivets shall be spaced not more than 10 inches center to center.

If corrugated pipe is laid in sections, the sections must be bolted or otherwise securely fastened together.

#### MASONRY.

*General:* All masonry will be included under the following heads, viz: Brick masonry, rubble masonry, dry rubble masonry, slope wall, plain concrete, and reinforced concrete, and will be estimated and paid for by the cubic yard in place.

*Brick Masonry:* The brick shall be of good quality, hard burned entirely through, and regular and uniform in shape. They shall be laid in mortar of a kind and quality to be determined by the engineer. Each brick shall be laid in a full bed of mortar on bottom, sides and ends, the mortar to be separately placed on each brick before laying. The joints shall not exceed  $\frac{3}{8}$  inch nor be less than  $\frac{1}{4}$  inch in thickness and shall

be neatly struck or flush-pointed. Every sixth course shall be headers. No bats shall be used except in the backing of walls (the proportion to be determined by the engineer) and nothing smaller than half-bricks will be allowed.

*Rubble Masonry:* Rubble masonry will consist of stones roughly squared, laid in Portland cement mortar. Stones must be hard, durable and reasonably flat. Not more than one-third of the stone shall be less than one foot thick and no stone shall be less than six inches thick and have a bed area of less than one foot. No stone shall be used in the face that has more height than breadth of bed. Walls must be compactly laid, using large, flat, selected stone in the bottom and having at least one-fifth the surface of the back and face headers, with all the spaces in the heart of the wall filled with suitable stones and spalls thoroughly bedded in cement mortar. In mixing mortar, the sand and cement should be mixed dry and small batches in proportions as directed, on a suitable platform, which must be kept clean and free from all foreign matter; then water is to be added, and the whole worked until thoroughly mixed and leaves the hoe clean when drawn from it. It must not be retempered after it has begun to set. Arch ring stones shall be full size throughout, rough dressed with the exposed inner surface rock faced, and shall be laid simultaneously from both bench walls with mortar joints not exceeding one inch in thickness. Arch centers shall not be struck until directed by the engineer. The tops of walls shall be finished with coping stone of good shape, with close joints at the ends, and not less than six inches thick, and one and one-half feet wide, and a length at least one and one-half times the breadth.

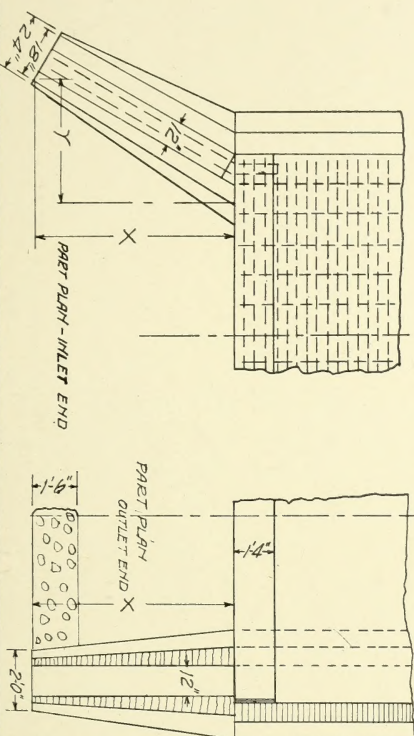
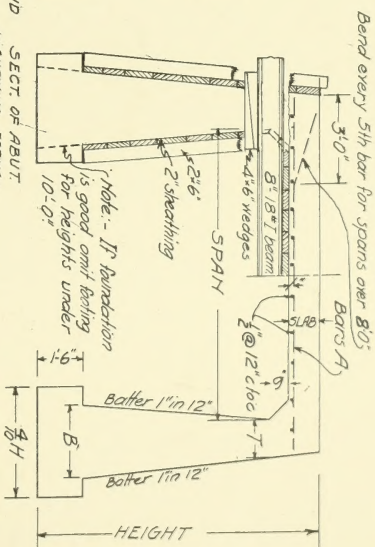
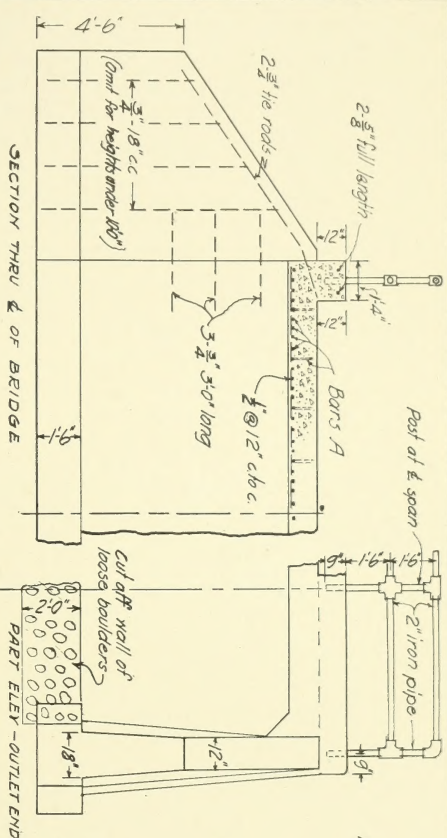
*Dry Rubble Masonry:* Dry rubble masonry shall conform to all the requirements for rubble masonry except that no mortar will be used; and the additional requirements given in this section. Flat stones at least twice as wide as thick will be used. The different sizes of stones must be evenly distributed over the whole face of the wall, generally keeping the larger stones in the lower part of the wall. Work must be well bonded and present a reasonably true and smooth surface, free from holes or projections, double-faced and self-sustaining.

*Slope Walls:* Slope walls shall be built of such thickness and slope as may be required by the engineer. Stones shall be placed at right angles to the slope and no stone shall be used which does not reach through the wall.

### CONCRETE

*General:* Plain concrete will contain no reinforcing steel; reinforced concrete will contain reinforcing steel; otherwise, both plain and reinforced concrete will conform to the plans and these specifications.



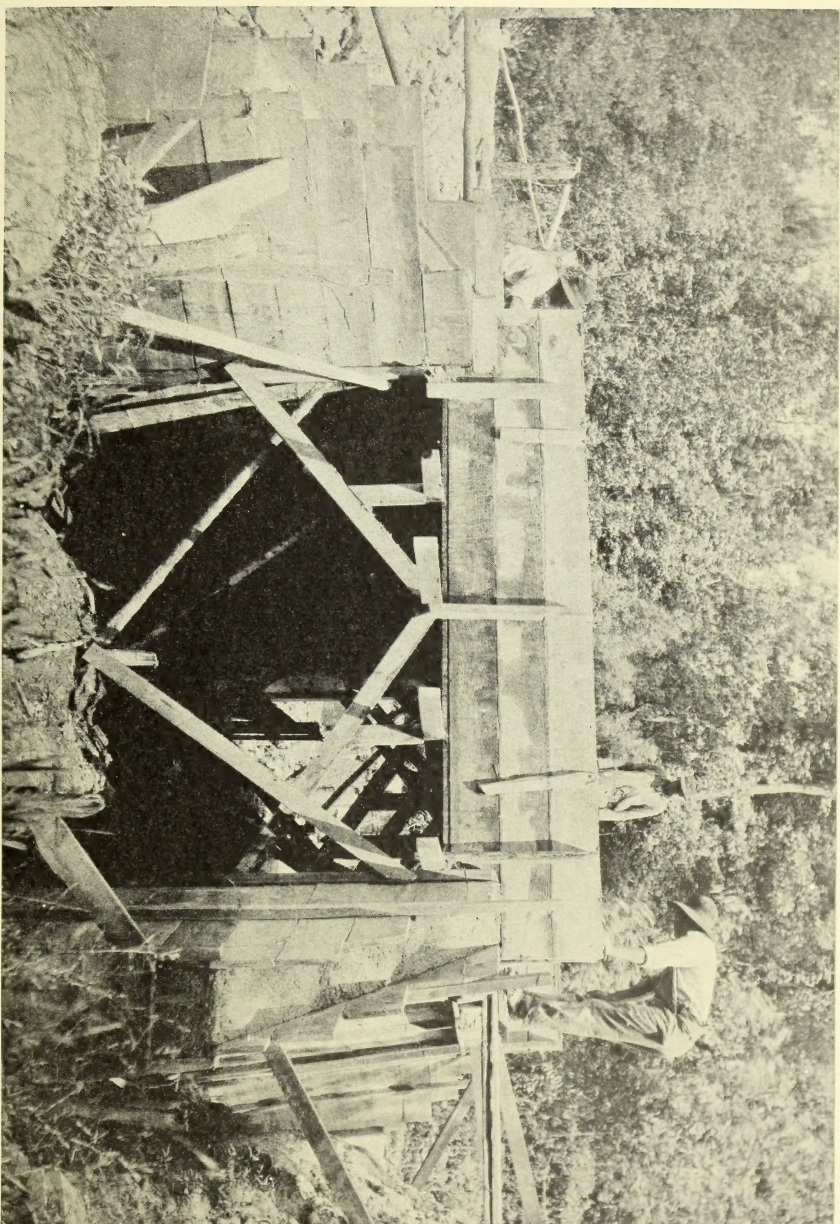


SPAN	SLABS PER FT. LENGTH		1-ABUTMENT LENGTH		2-MIDNIGS								
	TOTAL THICKNESS	CONCRETE	STEEL	WEIGHT	HEIGHT	CONCRETE							
FT	INS	INS	INS	INS	INS	INS							
6	9"	0.22	0.24	28.5	6	0.34	1'-9"	15"	1.78	2.05	None	2'-3"	1'-4"
7	10"	0.28	0.31	35.2	8	0.53	2'-1"	15"	3.54	4.10	6.4	5'-3"	5'-0"
8	10"	0.31	0.35	43.7	10	0.81	2'-8"	18"	8.65	10.0	10.2	8'-5"	4'-9"
9	11"	0.37	0.41	47.8	11	0.93	2'-10"	18"	11.4	13.2	11.0	9'-9"	5'-8"
10	12"	0.45	0.49	56.0	12	1.07	3'-0"	18"	14.6	16.9	12.2	11'-3"	6'-6"
12	13"	0.57	0.61	82.0	14	1.43	3'-6"	20"	22.7	26.5	15.3	14'-3"	8'-3"

Parapet wall not included in table  
All steel square bars \* For rubble abutments add 9 in. to B & T



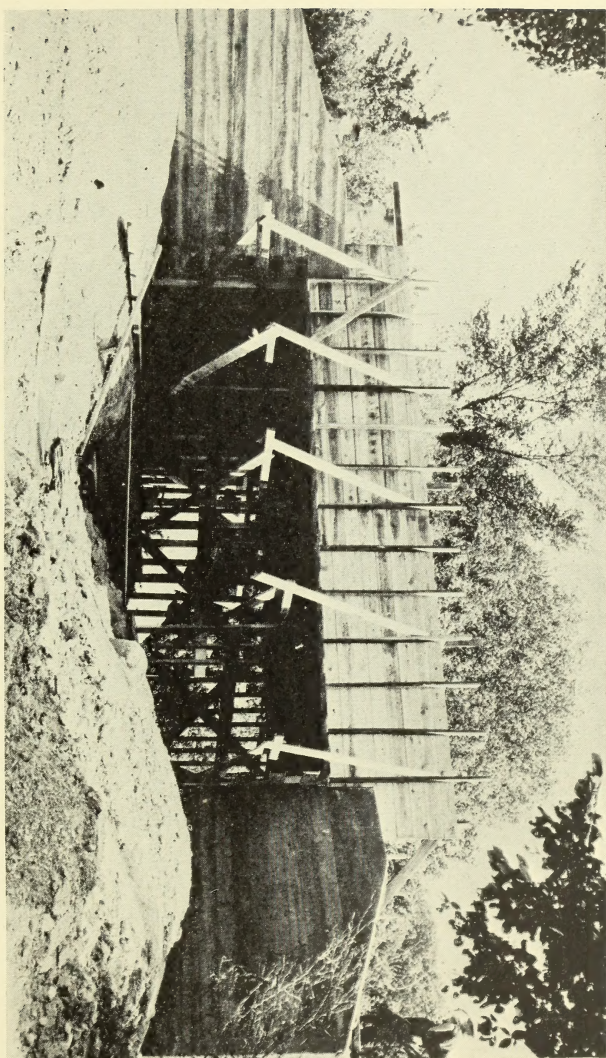




Forms for a Reinforced Concrete Slab Bridge.  
( Courtesy Atlas Portland Cement Co., New York, N. Y. )







Reinforced Concrete Bridge Construction. (Note method of bracing the forms.)  
(Courtesy Illinois Highway Commission, Springfield, Ill.)





*Cement:* A well-known brand of Portland cement shall be used which will meet the requirements of the specifications of the American Society of Testing Materials. Sufficient means shall be used to protect the cement against dampness and no cement shall be used which has become caked from exposure to dampness.

*Sand:* Sand shall be clean, hard, and coarse, and of grains varying in size. It shall be free from sticks and other foreign matter, but it may contain clay or loam not to exceed five (5) per cent. Crusher dust, screened to reject all particles over one-quarter ( $\frac{1}{4}$ ) inch in diameter, may be used instead of sand, if approved by the engineer.

*Stone:* Stone shall be sound, hard, and durable, and crushed to sizes not exceeding two and one-half inches in any direction. For reinforced concrete sizes are usually not to exceed one inch in any direction, but may be varied to suit character of reinforcing material. No stone exceeding one inch in any direction shall be used in stone or gravel concrete eight inches thick and under.

*Gravel:* Gravel shall be composed of clean pebbles of hard and durable stone of sizes not exceeding two inches in diameter, and shall be free from clay and other impurities except sand. When containing sand in any considerable quantity the amount of sand per unit of volume of gravel shall be determined accurately, to admit of the proper proportion of sand being maintained in the concrete mixture.

*Water:* Water shall be clean and reasonably clear, free from alkali and injurious salts.

*Proportioning:* The proportion of the materials in the concrete shall be as indicated on the plans, or as set forth herein upon the lines left for that purpose; the volume of cement to be based upon the actual cubic contents of one barrel of the brand of cement used.

Part of Structure	Parts by Volume			
	Cement	Sand	Gravel	Broken Stone
Footings.....				
Side walls.....				
Wing walls.....				
Slabs.....				
Slabs and beams.....				
Piers.....				

These proportions may be varied slightly from time to time by the engineer in order to secure a mixture of greater density. It is desirable that sufficient mortar be used to fill the voids in the aggregate and give a 10 per cent surplus of mortar. In proportioning gravel all material exceeding one-fourth ( $\frac{1}{4}$ ) inch in diameter will be considered as stone. Where necessary stone or sand shall be added to the gravel to secure the required proportions.

*Mixing by Hand:* Tight platforms shall be provided of sufficient size to accommodate men and materials for the progressive and rapid mixing of concrete. Batches shall not exceed one cubic yard each, and smaller batches are preferable, based upon a multiple of the number of sacks of cement to the barrel.

(a) Spread the sand evenly upon the platform, then the cement upon the sand and mix thoroughly until of an even color. Add all the water necessary to make a thin mortar and spread again; add the gravel, if used, and finally the broken stone, both of which, if dry, should first be thoroughly wet down. Turn the mass until thoroughly incorporated, and all the gravel and stone is covered with mortar; this will probably require the mass to be turned four times.

(b) Another method, which may be permitted at the option of the engineer, is to spread the sand, then the cement and mix dry, then the gravel or broken stone; add water and mix as above.

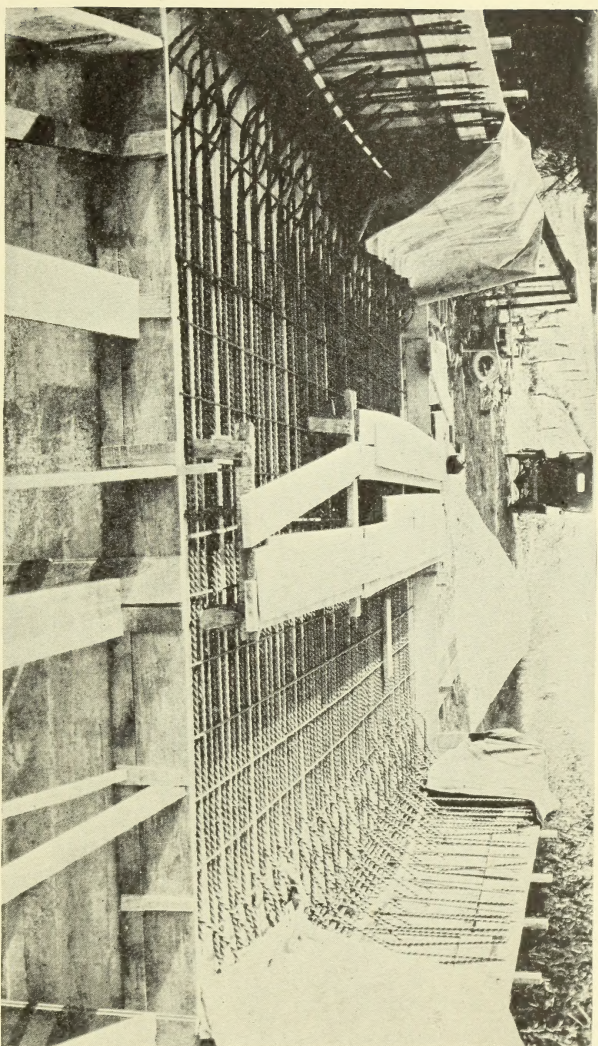
*Consistency:* The concrete shall be of such consistency that when dumped in place it will require little tamping. It should be spaded down and tamped sufficiently to level off, and the mortar should rise freely to the surface.

*Mixing by Machine:* A machine mixer shall be used wherever the volume of the work will justify the expenses of installing the plant. The necessary requirements for the machine will be that a precise and regular proportioning of materials can be controlled and that the product delivered shall be of the required consistency and thoroughly mixed.

*Forms:* Forms shall be well built, substantial and unyielding, properly braced or wired together, and shall remain true to the lines given when the load comes upon them. Dressed lumber shall be used for all exposed faces and the joints in the forms shall be such that there will be no leakage. Beam forms shall be given a slope of not more than one inch to the foot to insure ease in striking. Where corners and projections occur suitable molding shall be used in the angles of the forms to round or bevel them.

All forms shall remain in place until in the opinion of the engineer it is safe to remove them. Slabs shall remain supported not less than



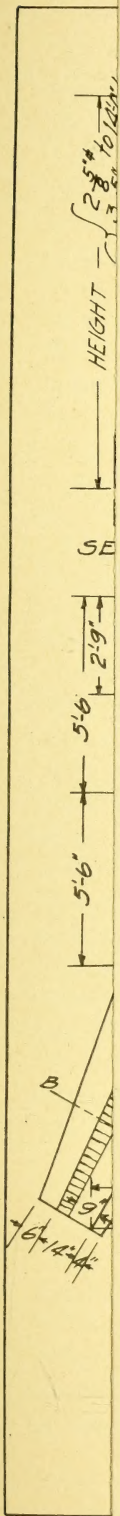


Reinforced Concrete Bridge Construction. (Note the running board for placing the concrete without disturbing the reinforcing steel.)

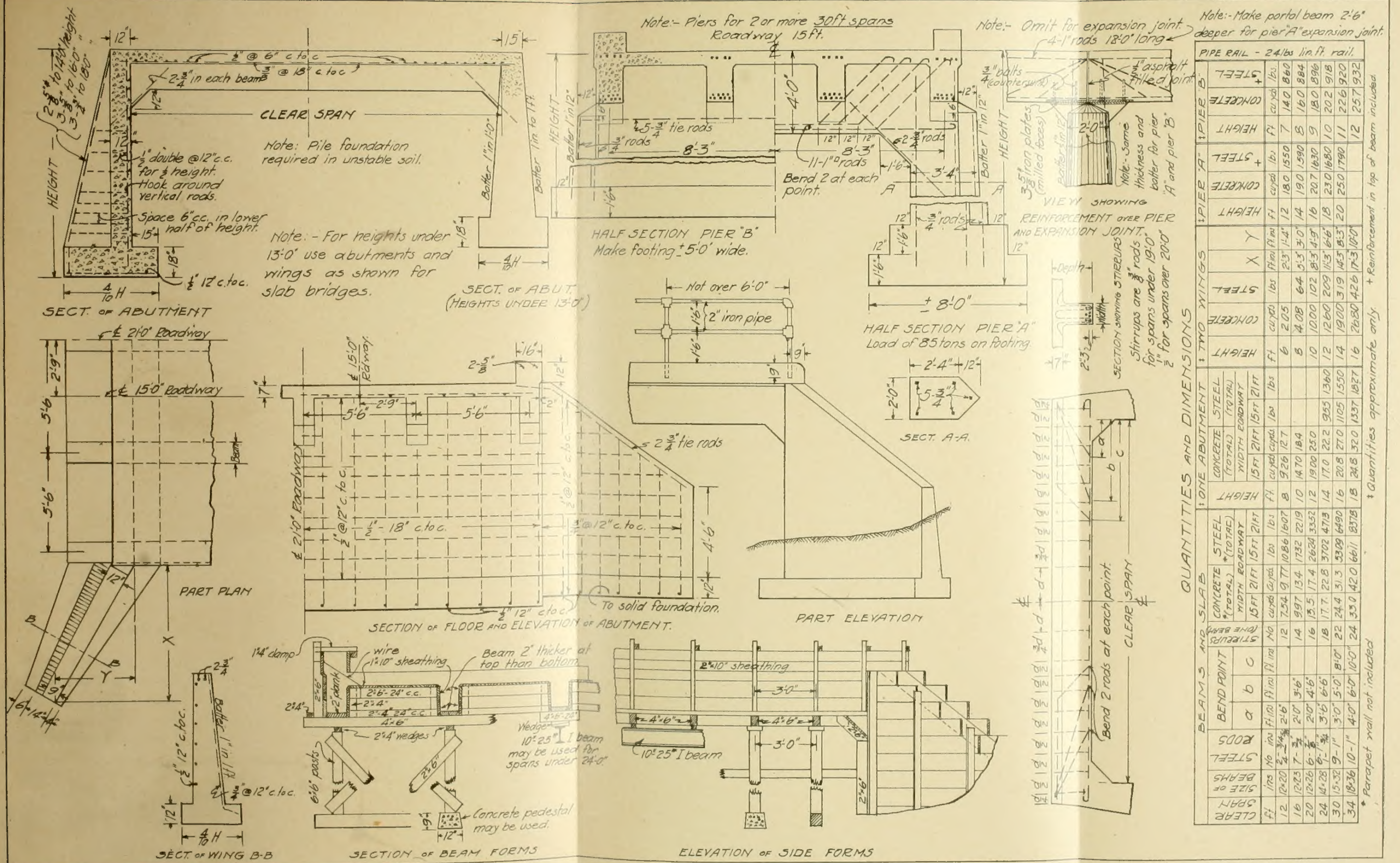
(Courtesy Illinois Highway Commission, Springfield, Ill.)











Reinforced Concrete Slab and Beam Bridges.



seven days, beams and girders not less than two weeks, and arches not less than twenty-eight days.

*Placing Concrete:* Concrete shall be placed immediately after mixing and any having an initial set shall be rejected. All concrete shall be carefully deposited in such manner that the stone and mortar will not separate. When deposited in small quantities, the concrete shall not be thrown directly against the forms, but so placed that the layer may be worked along at its full thickness. As fast as the concrete is placed the portion next to the forms shall be so treated by spading or other means, as to push back the stone and bring the mortar in thorough contact with the forms. The work shall be carried up in sections of convenient length, and each section completed without intermission. Concrete shall be placed in continuous horizontal layers in walls and beams. In slabs, the concrete shall be placed the full thickness continuous across the span. Arch concrete is to be laid in continuous rings, or, at the discretion of the engineer, in segments parallel to the axis of the arch. Forms shall be thoroughly drenched with water just before placing concrete.

*Joints:* When making any joining to old concrete, the surface shall be roughed, drenched with water and coated with neat cement paste. If the work is interrupted for 24 hours or more and there are no reinforcing rods projecting, a timber shall be so bedded in the face of the concrete that a lap joint at least four inches wide and deep will be formed when laying concrete is resumed.

*Finish:* The forms covering what will be the exposed faces of the concrete shall be removed as soon as the engineer deems safe and all crevices neatly filled with a stiff mortar of the same proportions as the mortar in the concrete, and thoroughly rammed in place. All exposed faces shall be so finished that they have a smooth and neat appearance. No plastering will be permitted, bumps must be rubbed or chiseled smooth. When concrete is laid in freezing weather the directions of the engineer as to mixing, placing and protecting the work shall be followed absolutely.

*Protecting Work:* Exposed surfaces must be kept wet for one week after the concrete is in place, and in hot weather must be protected from the direct rays of the sun.

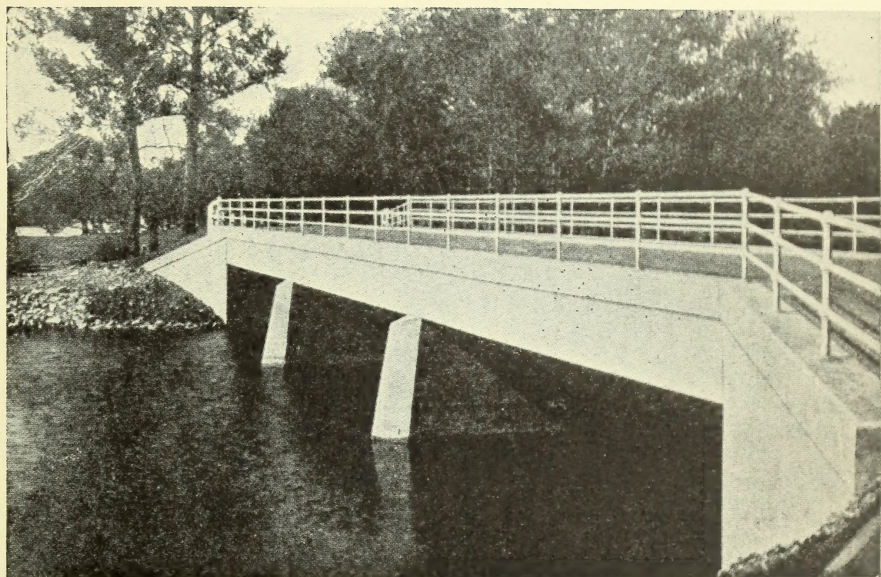
No heavy loads will be allowed to cross a concrete structure until permission is granted by the engineer.

*Reinforcing Steel:* So far as possible all steel shall be placed in its proper position and securely wired together before any concrete is placed. Steel shall not be placed closer than one inch to the forms and special care shall be exercised to secure a thorough flow of concrete

around and under the steel reinforcement. In splicing bars they shall be lapped from 15 to 50 diameters, as directed by the engineer, and securely tied together in not less than two places with No. 12 wire.

Where steel bars are shown on the drawings they shall be twisted square section bars, or bars of the same net sectional area with some provision for rigid mechanical bond at frequent intervals. A slight amount of rust is not objectionable, but steel must be free from grease and scale. Steel bars shall be of medium steel, with an elastic limit of not less than 32,000 pounds per square inch, and shall bend without fracture 180 degrees about their own diameter. Expanded metal and wire fabric shall have not less than a three inch mesh and an elastic limit of not less than 55,000 pounds per square inch.

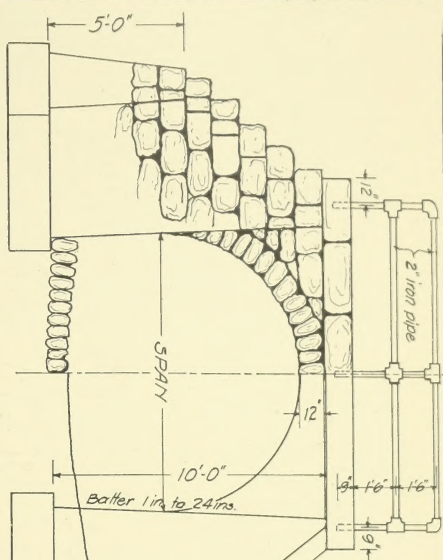




Reinforced Concrete Slab and Beam Bridge.





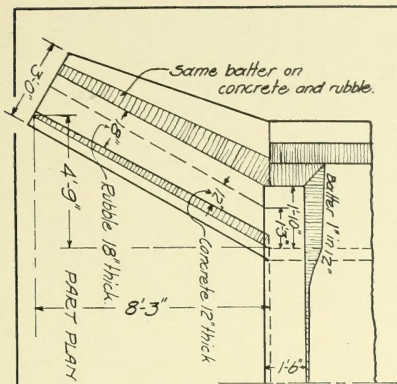


HALF END VIEW - RUBBLE-

HALF END VIEW - CONCRETE-

RUBBLE HALF SECTION

CONCRETE HALF SECTION

PART ELEVATION  
- CONCRETE -

SPAN	CONCRETE				RUBBLE								
	C	T	B	SPAN WALLS & 4 WINGS -LIN FT-	C	T	B	SPAN WALLS & 4 WINGS BARREL -LIN FT-					
FT. ins				CONCRETE				STEEL					
6	6	1'-6"	4'-9"	256	185	0.89	14	10"	2'-6"	4'-9"	36.6	1.21	208
10	9	2'-0"	5'-0"	266	189	1.10	28	12"	3'-0"	5'-0"	37.5	1.40	246
14	12	3'-0"	5'-0"	276	193	1.39	30	15"	3'-9"	5'-0"	38.5	1.66	324

Note:- The footing shown as plus or minus and computed in the table as 1'-6" thick, must be carried to a solid foundation.





PUBLICATIONS  
OF THE  
NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*
2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*
4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*
5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*
6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Out of print.*
7. Forest Fires: Their Destructive Work, Causes, and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*
8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*
9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*
10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Out of print.*
11. Corundum and the Basic Magnesium Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*
12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *Postage 8 cents. Cloth-bound copy 30 cents extra.*
13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*
14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Out of print.*
15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *Postage 6 cents.*
16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *Postage 6 cents.*
17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *Postage 4 cents.*
18. Bibliography of North Carolina Geology, Mineralogy and Geography, with a list of Maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *Postage 25 cents. Cloth-bound copy 30 cents extra.*
19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*
20. Water-powers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *Postage 25 cents.*
21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *Postage 15 cents.*
22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *Postage 15 cents.*
23. Forest Conditions in Western North Carolina, by J. S. Holmes, 1911. 8°, 115 pp., 8 pl. *Postage 15 cents.*

ECONOMIC PAPERS.

1. The Maple Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*
2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*



3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal, in North Carolina.

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving Localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrence and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

Gives descriptions of Mines worked for Gold in 1903; descriptions of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mine; the Occurrence of Tin; in some detail the Occurrences of Abrasives; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analyses of Kaolin from Barber Creek, Jackson County, North Carolina.

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904 and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities, Uses; describes the mineral Barytes, giving Method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a List of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Out of print.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sand-lime Brick; Operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interest in Land, Phosphate Rock, Marl Beds.

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Out of print.*

14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *Postage 10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *Postage 15 cents.*

Takes up in detail the Copper of the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; descriptions of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Localities; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the Uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.



16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *Postage 4 cents.*

17. Proceedings of Drainage Convention held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *Postage 5 cents.*

18. Proceedings of Second Annual Drainage Convention held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *Postage 3 cents.*

19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *Postage 5 cents.*

20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *Postage 7 cents.*

21. Proceedings of the Third Annual Drainage Convention, held under Auspices of the North Carolina Drainage Association; and the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Postage 5 cents.*

22. Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Postage 3 cents.*

23. Mining Industry in North Carolina During 1908, '09, and '10, by Joseph Hyde Pratt and Miss H. M. Berry, 1911. 8°, 134 pp., 1 pl., 27 figs. *Postage 15 cents.*

Gives report on Virginina Copper District of North Carolina and Virginia, by F. B. Laney; Detailed report on Mica Deposits of North Carolina, by Douglas B. Sterrett; Detailed report on Monazite, by Douglas B. Sterrett; Reports on various Gem Minerals, by Douglas B. Sterrett; Information and Analyses concerning certain Mineral Springs; Extract from Chance Report of the Dan River and Deep River Coal Fields; Some notes on the Peat Industry, by Professor Charles A. Davis; Extract from report of Arthur Keith on the Nantahala Marble; Description of the manufacture of Sand-lime Brick.

24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *Postage 5 cents.*

25. Proceedings of Second Annual Convention of the North Carolina Forestry Association, held at Raleigh, North Carolina, February 21, 1912. Forest Fires in North Carolina During 1911. Suggested Forestry Legislation. Compiled by J. S. Holmes, Forester, 1912. 8°, 71 pp. *Postage 5 cents.*

26. Proceedings of Fourth Annual Drainage Convention, held at Elizabeth City, North Carolina, November 15 and 16, 1911, compiled by Joseph Hyde Pratt, State Geologist, 1912. 8°, 45 pp. *Postage 3 cents.*

27. Highway Work in North Carolina, containing a Statistical Report of Road Work during 1911, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1912. 8°, 145 pp., 11 figs. *Postage 10 cents.*

28. Culverts and Small Bridges for Country Roads in North Carolina, by C. R. Thomas and T. F. Hickerson, 1912. 8°, 56 pp., 14 figs., 20 pl. *Postage 10 cents.*

29. Report of the Fisheries Convention Held at New Bern, N. C., December 13, 1911, compiled by Joseph Hyde Pratt, State Geologist, together with a Compendium of the Stenographic Notes of the Meetings Held on the Two Trips taken by the Legislative Fish Committee Appointed by the General Assembly of 1909, and the Legislation Recommended by this Committee, 1912. 8°, .. pp. *Postage .. cents.*

30. Proceedings of the Annual Convention of the North Carolina Good Roads Association held at Charlotte, N. C., August 1 and 2, 1912, in Coöperation with the North Carolina Geological and Economic Survey, compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1912. 8°, .. pp. *Postage .. cents.*

#### VOLUMES.

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 30 cents extra.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Postage 30 cents.*

Vol. III. The Coastal Plain Deposits of North Carolina, by Wm. Bullock



Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson, and Horatio N. Parker, 1912. 8°, 509 pp., 62 pl., 21 figs. *Postage 35 cents.*

Pt. I.—The Physiography and Geology of the Coastal Plain of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller, and L. W. Stephenson.

Pt. II.—The Water Resources of the Coastal Plain of North Carolina, by L. W. Stephenson and B. L. Johnson.

#### BIENNIAL REPORTS.

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *Postage 6 cents.*

Administrative report, giving Object and Organization of the Survey; Investigations of Iron Ores, Building Stone, Geological Work in Coastal Plain Region, including supplies of drinking-waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *Postage 1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *Postage 1 cent.*

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Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *Postage 2 cents.*

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Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *Postage 2 cents.*

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Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *Postage 1 cent.*

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Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *Postage 2 cents.*

Administrative report.

Biennial Report, 1905-1906, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *Postage 3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *Postage 5 cents.*

Administrative report. Contains Report on Sand Banks along the North Carolina Coast, Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an investigation Relating to Clam Cultivation, by Howard E. Enders of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *Postage 10 cents.*

Administrative report, and contains Agreements for Co-operation in Statistical Work, and Topographical and Traverse Mapping Work with the United States Geological Survey; Forest Work with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry reports relating to Connolly Tract, Buncombe County, Transylvania County State Farm, certain Watersheds, Reforestation of Cut-over and Abandoned Farm Lands, on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Long-leaf Pine at Pinchurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats in North Carolina; list of Magnetic Declination at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the conditions of the North Carolina fish industries; report of the Survey for the North Carolina Fish Commission referring to dutch or pound-net fishing in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly on outside of package with name of sender, post-office address, etc.; a letter should accompany sample and stamp should be enclosed for reply.

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